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PLEASE RETURN

SOME FLOWERING BULBS

by

E. M. STRAIGHT

SUPERINTENDENT OF EXPERIMENTAL STATION FOR VANCOUVER ISLAND

WITH A CHAPTER
COMMON BULB DISEASES

By F. L. DRAYTON -

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
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DARWIN TULIPS

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SOME FLOWERING BULBS

INTRODUCTION

The success attending our efforts in the growing of bulbs and the magnificence and volume of our display of flowers year by year, have brought inquiries covering every phase of bulb-growing, not only from all parts of Canada but from many points to the south.

Though success has attended our effort, we have not been exempt from accompanying difficulties, for bulbs have been attacked by insects and disease in increasing numbers during recent years. In the attempt to solve some of these problems, much experimental work has been undertaken, a report of which will be found in its proper place. Though bulbs in this bulletin will be treated in a general way, especial attention will be given to Tulips, Narcissi and Hyacinths.

In an effort to determine how our bulbs would compare with others, and especially with those coming from Europe, tulips were sent to all the Experimental Farms and Stations in Canada, with the request that they be grown beside the best imported sorts. Accompanying the bulbs were questions regarding the comparative value of the flowers. These questions were: (1). How do the Sidney bulbs compare in size and appearance with the imported bulbs on their arrival at your farm? (2). How do the Sidney bulbs compare with Holland-grown bulbs (a) as to yield and vigour, (b) as to size and quality of bloom, (c) as to height, (d) as to intensity of colour of flower? (3). In your opinion, have the Sidney-grown bulbs given you as good, better or poorer results than imported bulbs?

The tabulated answers follow:—

REPLIES TO QUESTIONNAIRE *RE* SIDNEY BULBS

Station or Farm.	How do Sidney bulbs compare in size and appearance with the imported bulbs on their arrival at your farm?	How do Sidney bulbs compare with Holland land-grown bulbs: (a) as to yield and vigour, (b) as to size and quality bloom, (c) as to height, (d) as to intensity of colour of flower?	In your opinion have the Sidney-grown bulbs given you as good, better, or poorer results than imported bulbs?
Scott, Sask.....	Larger and much better appearance.	All varieties did not grow but where they did, growth was strong, leaves broad. (a) Much larger, $3\frac{1}{2}$ " across, 3" deep as compared with $2\frac{1}{2}$ ". (b) 14" as compared with 8-10". (c) Colours more intense.	Sidney bulbs that grew gave much better results than Holland grown bulbs. Holland bulbs did not do so well as usual.
Kentville, N.S.....	Much better in appearance and size.	Those grown a few years ago were better than similar varieties of Holland bulbs.	Better.
Summerland, B.C.....	Very favourably.....	No appreciable difference noted.	Perhaps not quite so good.

REPLIES TO QUESTIONNAIRE *RE* SIDNEY BULBS—*Continued*

Station or Farm.	How do Sidney bulbs compare in size and appearance with the imported bulbs on their arrival at your farm?	How do Sidney bulbs compare with Holland land-grown bulbs: (a) as to yield and vigour, (b) as to size and quality bloom, (c) as to height, (d) as to intensity of colour of flower?	In your opinion have the Sidney-grown bulbs given you as good, better, or poorer results than imported bulbs?
Indian Head, Sask.....	Sidney bulbs were slightly larger and firmer than the average of the imported bulbs.	Much superior to Holland grown bulbs in vigour, yield of bloom, size and quality of bloom. Colouring much superior to Holland-grown bulbs.	With the exception of the Duchesse de Parma all Sidney bulbs were later than imported bulbs averaging one week. Otherwise Sidney bulbs in every way superior to Holland-grown bulbs.
Kapuskasing, Ont.....	Sidney bulbs small and lighter.	(a) Better in yield and vigour; (b) Bloom larger and purer; (c) In height taller; (d) Intensity of colour better.	Better.
Morden, Man.....	British Columbia bulbs somewhat larger and equally attractive.	(a) 50% varieties superior; (b) Some greater, some less; (c) Somewhat shorter; (d) Better colour, deeper shades.	On the whole B.C. bulbs somewhat less uniform than Holland-grown.
Nappan, N.S.....	Larger and lighter in colour than Dutch bulbs.	Sidney bloom larger and taller. Not so true to colour as the Dutch.	In some particulars better.
Fredericton, N.B.....	Not quite so large but just as clear and bright in appearance.	Sidney bulbs gave equally as good results as Holland-grown in 3 varieties.	Equally as good.
Lennoxville, P.Q.....	Sidney bulbs larger and stronger.	Sidney bulbs more even in growth and shades more intense.	Sidney bulbs on the whole superior.
St. Anne de la Pocatière, P.Q.	Very favourably.....	(a) Just as good; (b) Slightly larger and equality of bloom equal; (c) Same height; (d) Equal to Holland-grown.	As good if not better than those coming from Holland.
Invermere, B.C.....	Appearance would have been equal to Holland if bulbs had been packed in chaff.	In all cases equal to Dutch.	As good and in some cases better.
Cap Rouge, P.Q.....	No difference in size or appearance.	No difference in yield or vigour. Intensity of colour the same. Bloom 25% larger than Holland bulbs.	As good as and in some varieties better.
Agassiz, B.C.....	In size equal to Holland-grown, in appearance brighter and smoother	Yields of Sidney bulbs better. Blooms larger and taller. Equal in intensity of colour to the Dutch.	Sidney bulbs as a whole superior to Holland-grown.
Brandon, Man.....	Sidney bulbs are larger and firmer.	Sidney bulbs produce more vigorous plants. Bloom is decidedly larger and better.	Decidedly better than Holland bulbs.

REPLIES TO QUESTIONNAIRE *RE* SIDNEY BULBS—*Concluded*

Station or Farm.	How do Sidney bulbs compare in size and appearance with the imported bulbs on their arrival at your farm?	How do Sidney bulbs compare with Holland land-grown bulbs: (a) as to yield and vigour, (b) as to size and quality bloom, (c) as to height, (d) as to intensity of colour of flower?	In your opinion have the Sidney-grown bulbs given you as good, better, or poorer results than imported bulbs?
Lethbridge, Alta.....	No variation.....	No variation.....	No variation.
Charlottetown, P.E.I.....	Rather larger.....	Well in all particulars. 100 per cent stronger and larger and very fine. Taller than Holland-grown sorts. Bloom large and very fine.	As good and in some varieties better.
Rosthern, Sask.....	Sidney bulbs much lighter in colour and thin skinned.	Sidney bulbs appeared to be equally good with those from Holland.	

From these replies the value of the home-grown bulbs may be gauged.

TULIPS

Among all the flowering bulbs we think the tulip is the most greatly loved. Too much cannot be said in its praise, especially the Darwin, which excels in brilliancy of colour, perfection of form, and in length and strength of stem. On Vancouver island tulips are at their best.

ORIGIN AND HISTORY

The tulip must have been an old garden flower in Turkey and Eastern Europe before anyone in Western Europe knew of its existence. It was a genuine surprise to Busbecquius, the ambassador of the Emperor Ferdinand, when he saw it in 1554 in a garden between Adrianople and Constantinople, but its loveliness accounts for its spread to the Western countries. In 1562 it reached Antwerp. In 1571 it reached Holland. In 1580 or thereabout it came to England, but it was much later before it reached France.

The tulip mania from 1635 to 1638 is the outstanding event in tulip history, when everyone in certain parts of what is now Holland was seized with a mad wish to buy or sell tulips. The ordinary work of the farm was given up. Rich and poor alike joined in the huge gamble. At the start everyone made money, but the crash came in 1637. Very many persons were ruined. The failure was not an unmixed evil, however, for out of it all some found their feet, and the industry continued. Meanwhile the tulip was gaining a high place among garden plants, and in the estimation of garden lovers. It would seem that no exact date has been determined as the time of the tulip's arrival in America. The Pilgrim Fathers may have brought it, but the exact truth is not known. At any rate the tulip has been grown for a long time on this continent, and in increasing numbers.

BOTANY

The tulip belongs to the family Liliaceae, lily family. A few distinguishing characters are as follows:—

1. The parts of the flower are almost invariably in sets of three, the perianth being of two such sets, and also the stamens. The flowers are therefore symmetrical. They are also regular.

2. The stamens are opposite the divisions of the perianth.
3. The ovary is nearly always three celled, and is superior.
4. Both underground and aerial stems are borne.
5. The leaves are mostly linear, seldom divided or toothed, and not divided into petiole and blade.
6. Capsule is a dry splitting (dehiscient) fruit with several united carpels.

TULIP—GROUPS OR CLASSES

Botanically tulips are classified into scores of species based on botanical differences, little known and of little interest to horticulturists. However, there are several well known groups catalogued in the most of the literature on the subject. Even these groups have been crossed and recrossed with each other, until their identity is not any too clear. Some of these are mentioned below.

1. **THE EARLY SINGLE TULIPS.**—The Early Single Tulips, of the Duc Van Thol type, are of small stature, excellent for first bloom and for early bedding. They do, however, lack the size of bloom and the substance of later kinds.

2. **DOUBLE EARLY TULIPS.**—Although not so elegant in form as the single varieties, they are an exceedingly useful and beautiful class of tulips, producing a brilliant and striking effect when planted in beds. The flowers are more substantial and last over a long period. Nearly all of them are adapted for forcing and make a fine display when grown in pots or pans but require to be forced slowly.

3. **DARWIN TULIPS.**—The Darwins are said to have been raised from seeds of the best "Bybloemens" by an unknown amateur in the north of France. This race was introduced into commerce in 1889 by the firm of Krelage & Son of Haarlem. They are distinguished by their strong stems, square bottoms, white or blue bases and robust growth. A true Darwin has no yellow about it. Their advent has done more than anything else to make the tulip the popular flower it is to-day.

4. **COTTAGE TULIPS.**—The tulips belonging to this class, owe their name to the fact that many of them have been found growing in the gardens of country houses and cottages in England and France. This class has both long or egg-shaped flowers, and sometimes more or less rounded flowers, as in Bouton d'Or and Faerie Queen.

5. **PARROT TULIPS.**—These strange and quaint varieties have been long known to tulip people. They are in fact cottage tulips with lacinated edges. The year 1690 is usually given as the first recorded date of a parrot tulip. They may have existed before that time—probably did. When still in bud, the flower looks somewhat like the head of a parrot, hence the name.

6. **THREAD PETAIED TULIPS.**—It is not known where this strange form came from. The petal leaves are very long and narrow.

7. **SUNDEW.**—All the segments have an edge of short excrescences, which remind one of those on the leaves of the little marsh-growing sundew. Hence its name. This variety was shown recently by R. H. Bath of Wisbech, England.

SOILS

All soils on the Saanich peninsula vary much. At the Experimental Station they change rapidly (from a heavy clay to a loam, to a sand, to a peat, to gravel) without any apparent reason. However, that part of the farm given to the bulb gardens for several years is a fairly uniform black soil, and classified as Maywood clays. This was found to be a difficult soil to work,

but excellent flowers and bulbs were produced with it. This will be spoken of as soil No. 1. For the last two years, largely from the standpoint of rotation, the bulb gardens have been moved to a lighter soil, slightly further up the slope and spoken of as soil No. 2 in the following table. In this table samples of our soil are compared with a sample from the island of Guernsey, one from the Netherlands (that is reported to be the type of soil best suited to bulb culture), and one from the average type of soil in the Netherlands used for the same purpose is shown.

MECHANICAL ANALYSES OF SOILS USED FOR GROWING BULBS IN THE ISLAND OF GUERNSEY, IN THE NETHERLANDS AND AT THE EXPERIMENTAL STATION FOR VANCOUVER ISLAND.

Locality	Fine gravel (2-1 mm.)	Coarse sand 1-05 mm.	Medium sand 0.5-0.25 mm.	Fine sand 0.25-0.05 mm.	Very fine sand 0.1-0.05 mm.	Silt 0.05-0.005 mm.	Clay 0.005-0 mm.
Island of Guernsey.....	5.6	7.8	4.8	12.1	15.8	38.3	15.3
Netherlands, best type of soil	0.0	0.4	19.5	78.5	0.7	0.6	0.4
Netherlands, average type of soil.....	0.3	0.6	10.3	76.7	2.5	5.5	4.0
Bulb gardens.....	A	A	A	A	A	A	A
Expt. Station.....	2.9	6.2	47.2	fine and	very fine	19.9	23.8
Sidney.....	B	B	B	B	B	B	B
	4.3	6.3	40.9			22.9	25.5

It will be noticed that the Sidney soils are high in clay and low in sand. This only emphasizes the fact that bulbs may be grown over a great variety of soils. All plants whose foliage disappears early in the year, or that lose their roots early in summer, as in the case of the tulip, demand a summer baking to mature properly. In light sandy soil they find this condition to perfection. In fact they dry out on practically all soils on the Saanich peninsula, since the summer rainfall is very light. If the tulip is a native of the Orient, no doubt it got this annual baking in its natural surroundings. If it is not possible to give it the dry and hot condition in the soil, they must be dug and "baked" out of it. (See *Harvesting*.)

FERTILIZER

Bulbs of commercial size may be grown in a bowl of distilled water, or in clean sand, and magnificent flowers produced, but this does not mean that for growing bulbs no fertilizer is needed. Well-rotted stable manure is excellent and may be safely used in large quantities. Fresh manure is not good, as it seems to carry with it certain germs detrimental to the bulbs. Fish meal, so much to the fore in British Columbia at present, is another fertilizer positive in its action, and safe in the hands of the amateur. It may be used at the rate of 500 pounds to the acre.

CULTURE

The tulip is one of the easiest plants to grow, but like others repays good care. For outdoor cultivation for spring bloom the bulbs should be set in September to November. September is the best time for Vancouver island conditions. When set early, the work is done before the advent of wet weather, and beside that finer flowers with longer stems may be looked for when bulbs are set early. Plant the bulbs four to six inches deep (to the bottom of the bulb) and four to eight inches apart, depending on the class or size of the plants, the closer distances being for the early single kinds, and the wider distances for the later and larger sorts. Care should be exercised to place all

the bulbs at the same depth, as otherwise they will not all bloom at the same time. In the colder parts of Canada, forest leaves spread over the beds serve as a protection during the winter, and are to be recommended, but are not needed on the Pacific coast. Various methods are followed in the making of the drills and covering the bulbs after being set. For this purpose we have found the hand plough of much use. In the spring it may be necessary to cultivate lightly to hold weeds in check, etc., but until after the blooming period little need be done.



PLATE 1.—Tulips in full bloom, Experimental Station, Sidney, B.C.

POT CULTURE FOR WINTER AND SPRING BLOOM

Prepare the soil by mixing two parts good garden loam, one part well decayed manure, and enough sand to make an open friable soil. Arrange drainage at the bottom of the flower-pots, pans or boxes, by means of putting in a thin layer of coarse gravel, pieces of pottery or small flat stones. Fill with soil lightly and then press the bulb into the soil, base down; cover the bulbs and press firmly all around. The bulbs should not be crowded nor set too far apart. The proportion of five tulip bulbs to a five-inch pot is effective planting. When the bulbs are planted, the receptacles should be set six inches below the soil surface, outdoors, in some protected place where it will be easy to get them as wanted. In cold districts, where intense freezing occurs, a protecting material of leaves, straw, or a non-freezing manure should be placed over the storage or burial place, to prevent the freezing of the covering soil. Where there is a good basement or cellar arrangement, giving dark cool conditions, such may be used instead of outdoor storage. Pots of bulbs that have been buried outdoors may be moved any time after six or eight weeks, and brought into the light for further development; the same is true for pots stored in the cellar under cold conditions. It is well to examine the pot or pan to see that full root development has taken place. Without full root development satisfactory blooms are not likely to develop. The soil should be kept moist continuously while the pots are in the cellar. When the bulbs are first brought into the light, the pots should be placed where the temperature is moderate and the light not too bright nor the atmosphere very dry. Water freely, but do not apply more than is necessary to keep the soil moist. Bring the required number of pots into the house every ten days, so that a succession of blooms may be had. When the flowers appear, remove the plant from the direct rays of the sun, as the blooms may be scorched by the sun shining through a window. The lower the room temperature, after the bloom appears, the longer the blooms will last. When the flower has withered, the plant may be stored in any place that is dry, light, and free from frost; ripening will then take place. When the leaves have bleached white, the bulb may be removed from the soil and stored until the following September. However the forcing of any bulb exhausts the plant very much, so that it may be better to discard it and purchase others.

HARVESTING

At the Experimental Station the tulips are dug when the flower stalk has bleached white, but has not become too brittle. This condition will obtain near the end of June or July on this coast, but will vary of course with the different provinces.

Tulips may remain in the ground some years if the tops are cut off, and if the maturing leaves are not smothered by other plants. In practice, however, the best results are not usually secured in this country after the bulbs have been in the ground for more than two or three years, though reports would indicate that this is possible. The tulips are dug each year at the Station farm, graded and new plantations set from the finest stock, while the smaller bulbs are set in the nursery row until they become of correct size. While the bulbs are being stored, say from July 1 to September, they should be placed, not in a cool cellar as is often advised, but in a shed, shielded from the direct rays of the sun but where they may be kept warm—in fact very warm.

BULB SIZES

The sieve is used for the most part in arriving at standard sizes for tulip bulbs, while the grading is done by hand. All inferior bulbs must be picked out, for no mechanical device will do it. Although we speak of sizes in cir-

cumference, it is after all diameter that is measured, because the size of a tulip bulb is the periphery of a circle whose diameter is equal to the greatest diameter of the bulb. The bulb caliper is a round hole. Bulbs which pass through an 11 centimeter orifice or screen and are caught by a 10 centimeter screen are called 10 to 11 centimeter bulbs, although they may differ greatly in shape and volume.

The sizers are usually so built that sizes varying one centimeter in circumference may be sieved out. It is then possible to recognize as many sizes as there are centimeters between the smallest and largest size of tulip bulb, or about twelve in all.

Commercial tulip bulbs are sorted into two or three sizes, referred to as first, second and third grades or sizes; although grading is another process, as has been pointed out, and is performed by culling by hand all imperfect bulbs. Having picked out his commercial sizes, say 10, 11 and 12 centimeter bulbs, the grower proceeds to size the remaining stock for planting. Usually these run 5-6-7 and 8 centimeters. The smaller sizes are used only where a given variety is very scarce, but the time necessary to bring it to maturity makes serious inroads in the anticipated profit.

With the narcissi the separation of the merchantable from the planting stock, which involves also the breaking apart of the bulk clump, is essentially handwork. The operations cannot be done by any machine known to the writer. In commerce there are three main qualities of these bulbs, depending partly but not wholly upon size. (1) Double nosed, (2) first size, and (3) second size. The first will usually give two flowers. The second is the largest single-flowered bulb, and the third is a smaller flowering size. In all of these categories there is no fixed standard of size, for each category is variable and must differ with the variety and conception of the seller.

PROPAGATION

In considering propagation, mention should be made of the fact that bulbs of all kinds are specialized buds. They are made up of a short and rudimentary axis closely encased in transformed and thickened leaves or bulb scales. These thickened parts are stored with nutriment which is used during subsequent growth. Bulbs are conveniently divided into two great classes—the scaly, or those composed of narrow and mostly loose scales, as in the lily; and laminate or tunicate, or those composed of more or less continuous and close fitting layers or plates, as in the onion.

The greater portion of tulip bulb increase is obtained through the natural method of increase, known as splitting or offsets. Small bulblets form at the base of the matured bulb. These develop and split away after one or two seasons' growth. A single bulb planted one season may be replaced by a cluster of bulbs in three or four years' time if conditions for growth are suitable. In developing the smaller bulbs to the first grade size, a good practice is to select an area of well drained sandy soil and prepare a trench twelve inches wide and six inches deep. On the bottom of the trench apply a good dressing of bone meal, cover and mix with the soil. In this prepared trench plant the small bulbs two inches apart, cover with soil to ground level and let the bulbs grow for three years. This arrangement or the annual digging are quite satisfactory.

The most of the new varieties arise from seed. The production of new sorts from seed is slow, and there is a natural inhibition against growing anything from seed that does not bloom within two years at the latest, and this seems to apply more especially to bulbs. When tulips are grown from seeds, the flowers at first are usually self-coloured. The same bulbs when grown for a few years tend to "break" into mixed colours, particularly into feathered markings. The self-coloured state is a breeding stage for other kinds. When

the bulbs are multiplied asexually they reproduce the stage in which they then are; if propagated in the breeder stage they give self-coloured flowers; if in the "broken" stage, they give parti-coloured flowers such as the Flamed Bizarre including (a) Bizarres, with yellow bases and yellow grounds with dark markings; (b) Roses, with pure white bases and grounds and with markings of some shade of red or rose; and (c) Bybloemens, with pure white bases and grounds and markings of some shade of purple. In the Feathered Bizarre the colour is confined to the edges of the petals whereas in the Flamed Bizarre the colour is diffused all over the petals in a more or less regular manner. Where the coloured marking is confined to the edge of the petals, a flower is said to be feathered. When there are in addition coloured markings in the centre of the petals as well as on the edges a flower is said to be "Flamed."

EXPERIMENT TO FIND THE WEIGHT OF INCREASE IN BULBS BY MANIPULATING THE BLOOM AT CERTAIN PERIODS

50 bulbs allowed to bloom and seed.

50 bulbs allowed to bloom, bloom cut at prime.

50 bulbs allowed to bud and cut at commencement of bloom.

Name of variety	Date of planting	Treatment	Yield-Grades			Weight of bulbs lb. oz.	Began to bloom
			1st	2nd	3rd		
Tulip Artus.....	Oct. 24	Mature.....	77	52	105	6 14	April 8-May 3.
" ".....	" 24	Prime.....	83	82	83	7 3	
" ".....	" 24	Bud.....	88	28	82	6 6	
Tulip Duchesse de Parma	" 24	Mature.....	59	60	52	4 10	April 3-April 30
" ".....	" 24	Prime.....	62	65	51	5 6	
" ".....	" 24	Bud.....	54	68	71	5 7	
Tulip Chrysolora.....	" 24	Mature.....	50	0	17	3 ..	April-May 3
" ".....	" 24	Prime.....	50	12	102	4 2	
" ".....	" 24	Bud.....	50	23	112	2 10	

Though the bulbs from which the blooms had been plucked in their prime were very good, we are satisfied that the best are produced only when the flower stalk is allowed to remain until the bulb is mature. In common with many other plants the seed pod should be removed.

TULIP INCREASE

Name of variety	Number planted	Grade-increase			Total yield
		1st	2nd	3rd	
Tulip Darwin Beauty.....	53	100	30	83	213
" " Sultan.....	103	100	60	95	255
" " Leonardo da Vinci.....	100	100	37	143	280
" " La Tulipe Noire.....	50	75	74	..	140
" " Anton Roozen.....	100	100	60	61	221
" " Clara Butt.....	100	115	100	268	483
" " Couleur de Cardinal.....	500	500	176	460	1,136
" " Yellow Prince.....	200	225	150	311	686
" " Caledonia.....	25	50	93	76	219

It will be noted that the increase was quite good, but varying much with the variety.

In 1924 an attempt was made to obtain exact information on the rate of natural increase of the various sizes of bulbs, first grade, second grade and baby bulbs. The bulbs used in this experiment were weighed before planting. Rows were one foot apart and 12 feet long. Clara Butt was the variety planted October 4, 1924.

BULBS—RATE OF INCREASE

Sizes	Weight before planting	Weight har- vested	Weight in- crease	Num- ber of large size	Weight	Num- ber of 2nd size	Weight	Num- ber of small size	Weight	Total num- ber bulbs	Num- ber which bloomed
	lb. oz.	lb. oz.	lb. oz.		lb. oz.		oz.		oz.		
1st (50).....	2 1	4 7	2 6	66	2 12	50	15	80	10	193	50
2nd (100).....	1 12	4 11	2 15	80	3 03	50	14	600	10	190	64
3rd (200).....	1 10	5 5	3 12	80	2 12	100	12	205	18	385	44

The tabular results show that:—

1. There was a slight increase in total weight of the second grade bulbs over the first grade.
2. The small bulbs which are frequently discarded gave the best results in gain in total weight, and in natural increase in first and second grade bulbs.

It will be borne in mind that in the foregoing table comparisons are made between 50 first-grade, 100 second-grade and 200 baby bulbs, when each grade occupied the same length of row.

BULB RIPENING AND STORING EXPERIMENTS

In an experiment to find at what stage of ripeness it is best to lift tulip bulbs from the soil and what method of storage would give the best results, ten rows of tulips were used, all of which had been set from the same uniform stock of bulbs of the Pottebakker White variety. The bulbs were set in a red sandy loam soil. The period of bloom for all rows was from April 17 to May 23. Commencing the first week in June one row was lifted each week.

Variety	Date planted	Period of bloom	Date of lifting	Condition	Remarks
Pottebakker.....	Oct. 27	April 17 to May 23	June 6	Poor.....	
White.....	" 27	" 17 " 23	" 16	Very fair....	
"	" 27	" 17 " 23	" 24	Very good	
"	" 27	" 17 " 23	" 30	Excellent..	Primary axis still attached.
"	" 27	" 17 " 23	July 7	" ..	Primary axis still attached.
"	" 27	" 17 " 23	" 15	" ..	Primary axis getting weaker.
"	" 27	" 17 " 23	" 21	" ..	Primary axis still united.
"	" 27	" 17 " 23	" 27	" ..	Epidermis beginning to split.
"	" 27	" 17 " 23	Aug. 4	" ..	Bulbs well cured but
"	" 27	" 17 " 23	" 12	" ..	epidermis had begun to split.

INSECTS AND DISEASE

Insects have not been troublesome here, although the Daffodil fly is said to have given trouble in some places.

Tulips are subject to several rots in the bulbs, and blights on the foliage. Treating the bulbs with formalin, as for potatoes, and planting on land on which tulips had not been grown the year previously, will control the difficulty, in so far as we have observed it.

LIST OF VARIETIES

EARLY SINGLE TULIPS

*Outstanding sorts are marked (X).

WHITE

- Diana* (X). An immense flower of the purest white on a strong stem. Forces well.
Lady Boreel (X). Snow white, large pointed flower of perfect shape. Excellent for forcing in pots or pans, but not for cutting.
White Beauty (X). Large pure white sport of the great Pink Beauty.
White Hawk (X). The large flowers are intensely white and have an unusual substance.
White Swan. Large egg-shaped flower. Fine for cutting.

WHITE AND YELLOW

- Brunhilde*. A sport of Pottebakker, pure white with a curious marked yellow base.

WHITE, FLUSHED PINK

- Blushing Bride*.
Cullinan (X). A sport of Flamingo, middle of petals yellowish white with a border of delicate rose.
La Reine Maxima (X). White slightly shaded rose.
Pink Elegans (X). One of the newer varieties.

WHITE, EDGED PINK

- President Cleveland*. Very large. The immense petals are creamy white with a border of beautiful light pink. Not good for cutting.

DEEP ROSE AND WHITE

- Diadem* (X). A silvery shining bright pink.
Ibis. A gigantic dark sport of Flamingo.
Jenny (X). Beautiful silky rose, very attractive. Large flower.
Le Matelas. Glistening rosy pink, flushed creamy white.
Pink Beauty. Beautiful vivid cherry-rose with white stripe through centre of petals.
Princess Wilhelmina (X). Deep rosy red, flushed white, long pointed flower.
Rose Van Dekema (X). Dark rose-pink.

DEEP ROSE

- Cramoisie Royal* (X). Large flower on a long stem. The best of this colour.
Proserpine. Rich silky carmine rose. An old tulip still popular.

CERISE

- Joost Van Vondel*. Long flowers of beautiful shape.

SCARLET

- Brilliant Star* (X). Vermilion scarlet with a bluish black star at base. One of the best.
Cramoisie Brilliant. Good forcer.
Couleur de Cardinal (X). Excellent flower, held upright by a tall strong stem. Fine bedder and late forcer.
Sir Thomas Lipton (X). Large cup-shaped flower of great substance. Good bedder, poor forcer.
Vermilion Brilliant (X). Yellow base, most brilliant, good forcer and bedder.

ORANGE-SCARLET

- Prince of Austria* (X). Sweet scented. Flowers borne on tall strong stems.

ORANGE

- Fred Moore* (X). Dull rosy terra-cotta. Long stem. Fine for forcing and bedding.
Max Havelaar (X). Blood-orange, flushed salmon-rose.

ORANGE AND YELLOW

- Cardinal Rampollo* (X). Clear yellow bordered orange-red. Easy forcer.
Cottage Boy. Canary-yellow, bordered bronze-yellow. A sport of Cottage Maid.
De Wet (X). Golden yellow, flushed and stippled deep orange. Large sweet-scented flower of stately habit.
Golden Lion (X). Clear light yellow with irregular edge of terra-cotta. Fine for bedding.

YELLOW

Gold-Finch (X). Deep yellow, sweet-scented. A sport of Yellow Prince.
King of the Yellows. Good forcer, poor bedder.
Mon Trésor (X). Intense golden yellow. One of the earliest and best forcers.
Ophir D'or.
Prince De Ligny (X). Long pointed flower on tall strong stem.
Rising Sun (X). A real giant on an immensely tall and strong stem. The best of the yellows for bedding or forcing.
Yellow Prince.

PRIMROSE

Calypso (X).
Primrose Queen. Primrose, edged canary yellow.

PURPLE

President Lincoln. Loosely formed flowers on a strong stem.
Van Der Neer (X). Very popular in Scandinavian countries.

RED AND YELLOW

Keizerskroon (X). One of the most popular. Bright crimson-scarlet, edged deep rich yellow.
Standard Golden (X). One of the oldest tulips in existence. Very beautiful.

PURPLE, EDGED WHITE

Cerise Grisdelin (X). Dark carmine-violet, shaded fawn and margined creamy white.
L'Espérance (X). Garnet-purple, broadly bordered with very pale rose.

OTHER COLOURS

Hobbema (X). Old rose, flushed buff.
L'Intéressante. Pale mauve, edged white, with a star at the base.
Queen Alexandra (X). A sport of Pottebakker. Very fine lilac.

DOUBLE EARLY TULIPS

WHITE

Boule de Neige (X). Pure white. An elegant peony-like flower on a strong stem.
Schoonoord (X). A sport of Murillo. Large and full flower. The best double white.

WHITE, FLUSHED PINK

Murillo (X). The most popular double pink in existence.

ROSE

La Grandesse. Good forcer.
Salvator Rose.

DEEP ROSE

America.
Azalea (X). Carmine-pink. Good forcer.
Peach blossom (X). Sport of Murillo. One of the best.

SCARLET

Imperator Rubrorum. Used largely for forcing.
L'Aurore (X). Beautiful well shaped flower of good substance.
Le Matador (X). Rich glowing scarlet with purple bloom on the outside of the petals.
Vuurbaak (X). Fiery scarlet, tinged orange when open.

ORANGE AND RED

El Toreador (X). Bright orange scarlet with a broad border of buff yellow.

RED AND YELLOW

Titian. Forcing.
Tournesol Red. Rich scarlet, edged yellow.

YELLOW AND ORANGE

Couronne D'or (X). Golden yellow flushed orange red.

YELLOW

Golden King. Soft Canary yellow, shaded deeper yellow with black anthers.
Lady Godiva. Immense flower, weak stem.
Mr. Van Der Hoej (X). Sport of Murillo.

PRIMROSE

Tea Rose (Suffrano). Soft pure yellow, tinged light rose.

VIOLET

Electra (X). A beautiful violet sport of the well-known Murillo.
Lac Van Haarlem. Brilliant rosy violet. Quite unusual.
Turban Violet.

DARWINS

VERMILION-SCARLET

City of Haarlem. One of the largest. Large steel-blue base.
Glow. Good for massing in border.
Prince of Wales (X). Very large flower on strong stem. Fine for forcing.

COCHINEAL-RED

Bartigon (X). Pure white base.
Farncombe Sanders (X). Rosy Red, with white base.
King George V (X). Blue base.
President Taft (X). Ox-blood, blue base.
Professor Rauwenhof (X). Cherry-red, blue centre.
William Pitt (X). Very dark crimson, purple on outer petals.

CERISE

Pride of Haarlem (X). Brilliant rose-carmine with blue base.
Prince of the Netherlands (X). Very large, blue base.
Princess Mary (X). Bright carmine-rose, with margin of rose-pink.

PALE MAGENTA

Carmen (X). Carmine-rose. Filaments black.
Centenaire (X). Large flower. Perfect shape.
La Fiancée (X).
Matchless (X).
William Copland. Poor shape and colour.

ROSE WITH PALER MARGINS

Anton Roozen (X). White base.
Baronne de la Tonnaye (X). Fine bedder.
Edmee (X). Vivid cherry rose.
Madam Krelage (X). Bright lilac-rose, margined with silvery rose.
Massachusetts. Vivid pink. White base.

ROSE WITH PALER MARGINS

Aphrodite (X). Clear silvery rose-pink, inside deeper pink with blue base.
Carl Becker.
Le Notre.
Madame Burrois (X). A grand new tulip.
Princess Elizabeth (X). Clear deep pink, changing with age into rose-pink, white base.
Venus (X). One of the finest.

PALE ROSE WITH PALER MARGINS

Ethel Roosevelt.
Salmonia (X).
Suzon.

PALE ROSE WITHOUT PALER MARGIN

Flamingo (X). Pointed flower of refined form.
Psyche (X). Silvery rose, edged soft rose, with pale blue base.

SALMON—PINK

Afterglow. Deep rosy orange.
Clara Butt (X). Flushed salmon-rose, white halo.
Louise de la Vallière. Like Clara Butt but darker.
Orange Perfection (X).
Yolande.

BLUSH

La Candeur.
L'Ingénue.
Margaret.
Painted Lady.

BLACK

Mistery (X).
La Tulipe Noire.
Zulu.

PURPLE

Faust (X). Satiny purple with white base.
Giant (X). Reddish Purple.
Marconi (X). Opening blue-purple with maroon shading.
Sir Trevor Lawrence.

VIOLET-PURPLE

Jubilee (X).
Valentin (X).
Viking.

ROSE-LILAC

Dal ongaro.
Euterpe.
Theresia.

LILAC

Bleu Aimable. Pale lavender with white base.
Blue Céleste. White base, blue halo.
Dream. Popular. Poor stem.
Opal (X).
Reverend Ewbank.

LILAC WITH LIGHTER EDGE

Electra (X).
Mauve Clair (X).
Wally Moes.

SLATEY LILAC

Duchess of Hohenberg (X). Enormous long flowers on tall strong stem.
La Tristesse.
Oliphant (X). One of the best.
President Harding.
Remembrance (X).
Ronald Gunn.

COTTAGE

WHITE

Royal White.
Snowdon.
Water-lily.

WHITE, EDGED PINK

Carnation (X). The old English Picotee.
Elegans Alba (X).
Perle Royale (X).
Picotee. (Maiden Blush).

CREAM, FLUSHED PINK

Innovation (X).
Isabella. Weak stem, poor for forcing.
Pride of Inglescombe. Opening creamy white, edged carmine rose.

PINK

Inglescombe. Pink.
Mrs. Kerrell (X). Rose, edged soft salmon.
Pluto. Self-coloured rose-violet with white base and blue star, good-sized flower of beautiful colour and shape. Good forcer.
Sir Harry. Pale lavender-pink with yellow base and blue halo, large pointed flower.

COCHINEAL RED

Elegans. Brilliant crimson, long reflexing flower. One of the few Cottages which can be forced easily.

Fulgens. Clear crimson with yellow and white centre; long recurving petals on the tallest stem of all; a robust and showy garden plant.

Gesneriana Spathulata. (*Gesneriana Major*). Rich crimson-scarlet with brilliant blue base; large flower. Its enormous flowers of dazzling brilliancy make it one of the most popular cottage tulips. When fully open the bright blue base adds greatly to its beauty.

Glare of The Garden. Bright crimson-red, with black centre, edged yellow, long, large handsome flower. One of the best.

SCARLET

Coronation Scarlet. Bright scarlet, long flower with reflexing petals.

Inglescombe Scarlet. Vermilion-red with black base, large flower on a graceful stem.

Scarlet Emperor. Bright scarlet with a clear yellow base. The flowers are of enormous size, held upright by a strong stem.

ORANGE-SCARLET

Caledonia. Orange-scarlet. Compared with other late tulips a rather dwarf variety which should be planted by itself.

Cyclops. (See Goldfinder).

Goldfinder. Bright crimson, flushed orange, with yellow base.

Grenadier. Dazzling orange-red with rich yellow base, very large well-shaped flower on a tall strong stem. A grand tulip and the most beautiful in this colour.

La Merveille. Orange scarlet, flushed rose with yellow centre; long flower of beautiful shape; deliciously scented. Extra forcer and bedder.

Orange Beauty. Brilliant orange-scarlet, flushed purple on outer petals; long pointed flower of great beauty with greenish yellow base. Fine for beds or borders.

Orange King. Glistening deep orange, shaded rose; inside deep orange-scarlet with yellow base; sweet scented. Large globular flower. Very attractive for the border.

Prestance. Brilliant orange-red, most times having more than one flower on a stem, very early.

YELLOW

Avis Kennicott. Rich chrome-yellow with black base and anthers. Long flower of immense size, a beautiful variety of colouring.

Bouton d'or. Deep golden yellow with black anthers, medium-sized cup-shaped flower.

Elegans Lutea Maxima. Soft canary yellow, slightly flushed orange-red when fully opened. Large pointed reflexing petals. Fine for the border.

Gesneriana Ixioides. Deep yellow, tall and handsome flower on a strong stem. Fine for growing among shrubbery.

Golden Spire. (See *Elegans Lutea Maxima*).

Gold Dust. Chrome yellow edged with faint dull orange-red; good-sized flower with slightly reflexing petals.

Inglescombe Yellow. Glossy canary yellow, large globular flower of perfect form on a strong stem.

Mrs. Moon. Rich golden yellow with slightly recurving petals. Very large flower of great beauty and substance, carried on a tall strong stem. One of the most beautiful of all late tulips. Fine for forcing and for outdoor planting.

Viridiflora Praecox. Soft green, edged with yellow, beautiful large flower of erect habit; very fine for late pot culture. This variety is often substituted by unreliable firms with the common *Viridiflora*, which is not only lower in price but has much smaller flower.

Walter T. Ware. The richest deep golden yellow in cultivation. Broad globular flower, reflexing at the tip. Unusual substance.

PRIMROSE

Ellen Willmott. Opening primrose-yellow. Inside canary-yellow changing into bright yellow when the flower ages.

Elegans Lutea Pallida. (See Leghorn Bonnet).

Flava. Creamy canary-yellow, large flower on a stiff stem. Unusual substance. One of the latest to bloom.

Gesneriana Lutea Pallida. (Mrs. Keightley). Pale yellow enormous beautiful flower; sweet scented.

Leghorn Bonnet. Soft primrose with slightly reflexing petals. A very lovely tulip for the border and cutting.

Moonlight. Soft luminous canary-yellow, very large oval-shaped flower with outer petals reflexing at the tip. One of the finest in this colour. Good forcer.

PRIMROSE—*Concluded*

Retroflexa. Light yellow with recurving petals. Fine for cutting.

Retroflexa Superba. Similar to *Retroflexa* but much larger flower; small bulb.

Solfatare. Pale sulphur-yellow, large flower of graceful habit, fine border.

Solferino. Pale creamy yellow, edged soft canary-yellow long egg-shaped flower, in colour even paler than Moonlight. Very beautiful when planted in partial shade.

Vitellina. Light sulphur-yellow, passing off creamy white with age, sweet scented. Not recommended for forcing on account of its stem.

YELLOW, EDGED RED

Golden Crown. Opening pale yellow, edged crimson-red, golden-orange suffused orange-red when the flower ages. Fine for cutting and for late forcing.

SHOT

Fairy Queen (X).

John Ruskin (X).

The Fawn (X).

OTHER COLOURS

Chameleon. Pale heliotrope, canary-yellow base.

Dainty Maid. White, veined sky-blue.

Quaintness.

Striped Beauty.

Zomerschoon.

PARROT TULIPS

Admiral de Constantinople. Red, shaded orange.

Café Brun. Deep yellow, striped and feathered reddish brown.

Café Purple. Coffee colour and yellow.

Fantasy. Raised from Darwin Clara Butt, new.

Gemma. White, edged rose, new.

Lutea Major. Golden Yellow with a few crimson and green stripes.

Markgraaf Van Baden. Brownish red, feathered orange and purple.

Perfecta (Gloriosa). Golden yellow, blotched deep scarlet.

Rubra Major. Blood-red.

Sensation. A violet variegated sulphur-yellow tulip; enormous flower on a tall straight stem; extremely scarce.

NARCISSUS

The Narcissus, no doubt, received its name from Narcissus, who in Greek mythology was the son of the river god Cephissus and the nymph Leiriope, distinguished for his beauty. The seer Teiresias told his mother that he would have a long life, provided he never looked upon his own features. His rejection of the love of the nymph Echo drew upon him the vengeance of the gods. Having fallen in love with his own reflection in the waters of a spring, he pined away (or killed himself) and the flower that bears his name sprang up on the spot where he died. According to Pausanias, Narcissus, to console himself for the death of a favourite twin sister, his exact counter part, sat gazing into the spring to recall her features by his own, Narcissus, representing the early spring flower which for a brief space beholds itself mirrored in the waters and then fades, is one of the many youths whose premature death is recorded in Greek mythology. The flower itself was regarded as a symbol of such death.

ORIGIN AND HISTORY

The plant is a native of Central Europe, and the Mediterranean region. One species extends through Asia to Japan.

BOTANY

The Narcissus belongs to the family Amaryllidaceae, closely related to the lily. The family is described as follows: Plants with tunicated bulbs, from which arise the foliage and the flower scapes, leaves linear or even subulate usually appearing with the bloom; flowers white, yellow or seldom green,

erect or pendent, solitary or umbellate on the tops of the scape or peduncle, the spathe 1-leafed and membranous; perianth salver form, the tube varying in shape, the 6 segments equal or nearly so and ascending spreading or reflexed, the throat bearing a corona or crown which is long and tubular, or cup-shaped, or reduced to a ring; stamens 6, attached in the perianth tube, ovary 3-celled and the small stigma 3-lobed. The 6-parted perianth, 6 stamens with introrse anthers and inferior 3-celled ovary are together distinctive.



PLATE 2.—Narcissi in full flower, Bellingham, Wash.

(Courtesy of U. S. Dept. of Agriculture)

GROUPS AND CLASSES

There are five well-marked groups in Narcissi, but the forms that have arisen by crossing are legion and present many difficulties. The five groups may be enumerated as follows:

N. Bulbocodium. These have been commonly known as the hoop-petticoast narcissi, because the coronet in the centre of the flower is very large in proportion to the other parts; and much expanded like the old hooped petticoats.

N. Pseudo-Narcissus. This is the true daffodil, common in woods and thickets in most parts of the North of Europe, but is rare in Scotland. Its leaves are five or six in number, about one foot long. The stem is about eighteen inches long and the spathe single-flowered. The flowers are large, yellow, often scented and a little drooping, with a corolla deeply cleft into six lobes and a bell-shaped corona, which is crisped at the margin. In this species the corona is also very large and prominent, but is more elongated and trumpet-shaped.

N. incomparabilis. One of the large double flowers in this group is known as butter-and-eggs. *N. incomparabilis* includes all the mock narcissi or star daffodils, with coronets of medium size about half the length of the segments.

N. Tazetta. This group includes the polyanthus or bunch narcissi—a group well marked. The peculiarity of the class is that they produce many flowers on the one stem. In these the corona is small and shallow as compared with the perianth.

N. poeticus. This is a small group known as the poet's or pheasant's eye narcissi. The pheasant's eye Narcissi have a perianth large and spreading and conspicuous, with a corona very small and shallow. There are several well-marked varieties such as radiiflorus, poetarum, recurvus.

The Royal Horticultural Society has adopted eleven groups of Narcissi as follows:—

I. Trumpet Daffodils. Trumpet or crown as long or longer than the perianth-segments.

II. Incomparabilis. Cups or crown not less than one-third but less than equal to the length of the perianth-segments.

III. Barri. Cups or crown less than one-third the length of the perianth-segments.

IV. Leedsii. Perianth white, and cup or crown white, cream or pale citron, sometimes tinged with pink or apricot, embracing different dimensions.

V. Triandrus Hybrids.

VI. Cyclamineus Hybrids.

VII. Jonquilla Hybrids.

VIII. Tazetta and Tazetta Hybrids.

IX. Poeticus Varieties.

X. Double Varieties.

XI. Various.

It will be noticed that the classification is based on horticultural rather than botanical differences, and is an attempt to include the hybrids which have brought about so much confusion. As such it furnishes a useful purpose.

SOILS

Narcissi do well on a great variety of soils, and under a great variety of conditions. All varieties are easy of culture, especially in natural surroundings where they are as thoroughly at home as weeds. A few varieties thrive in wet ground, but on the whole succeed in good turfy loam, but no manure, rotted or otherwise, must touch the bulbs. Drainage should be provided, but moisture should be sufficient during the growing season. Later they must have a rest period. At such time the soils must be entirely dried out. A good turfy sandy loam, that becomes very dry during the summer, is about right, at least for most varieties.

FERTILIZER

Bone meal, wood ashes, fish meal, etc., are safe fertilizers for the narcissus. Well rotted stable manure applied the year before, well incorporated with the soil is recommended if such manure is available; but not in direct contact with the bulbs themselves, as advised under soils.

CULTURE

The best time to plant, to obtain the finest flowers is early autumn (as early as possible) although bulbs may be put in as late as November with fairly satisfactory results. We recommend early planting for the finest bloom with the longest flower stalk. The bulbs may be left undisturbed for years in ordinary good loamy soil, but on poor soils they are better lifted every two years. In the garden it is well to plant very strong bulbs, say six inches deep, and three inches apart, and allow them to remain until they form strong

groups, or until they show signs of too much exhaustion from numerous offsets. Weak or small bulbs should not go so deep. It is advised to cover the bulbs one and one-half their own depth or size, measuring the solid body part of the bulb and not the soft neck or top. As decaying foliage is unsightly in the garden a good plan is to cover the *Narcissi* bed with annuals when the bulbs are through flowering.

Most daffodils do fairly well in shade, but it must not be too dense. In the flower border, to obtain the best effect, daffodils should be planted in large groups of irregular outline, each group or clump to contain one variety only. Avoid straight lines, circles and symmetrical designs. Masses of daffodils should always appear in the hardy flower border, where irregular and effective sweeps can be planted between the clumps of herbaceous plants, which in their turn grow up and hide as well as shelter the daffodil foliage while it is maturing the bulb.



PLATE 3.—Planting daffodils at Bellingham, Wash.

(Courtesy of U. S. Dept. of Agriculture)

Many attempts have been made to naturalize the *Narcissi* in this country, but not with the same success as in the old land. No doubt greater success would be obtained if the planting were protected from the hot dry winds and in such a place where the grass may remain unclipped until the ripening period of the bulbs approaches. This period is readily discernible as the foliage will develop a yellow hue and wither. If the foliage is cut as soon as the flowering period is over, close to the ground as with a lawn mower, the vitality of the plant will be greatly impaired. In planting make the breaks large and bold, scattering the bulbs over the ground broadcast with the hand, and planting where they fall. *Narcissi* look beautiful when growing on grassy slopes, on banks, etc., and persist in such situations for many years.

To obtain very fine bloom, daffodils should be cut in a young state, just when the bud is bursting, placed in water and allowed to expand in a greenhouse or sitting room. The blooms opened in this way are larger and finer in texture and purer in colour than those which develop out-of-doors.

The forcing of *Narcissi* under glass has assumed immense proportions. For the most part these bulbs are imported from France and Holland. As soon as the bulbs arrive, they should at once be placed in pots or boxes in

which they are to be grown. If the bulbs are to be grown for home or conservatory decoration, a pot or pan, six or eight inches in diameter, is used. In this five to nine bulbs are placed depending upon their size. If grown in boxes for cut-flowers the ordinary greenhouse flat (shallow box) is used.

The best compost to pot Narcissi in is a mixture of two-thirds good fibrous loam, and one-third old decayed leaf-soil. To this add one and a half pounds of bone meal to every bushel of soil. The soil should be fresh and sweet, neither wet or sticky. Good drainage should be secured by placing some sort of drainage material in bottom of pot, such as broken pots, gravel or the like. This should be covered with fibre or moss. In potting, the larger bulbs need not be quite covered, and the level of the soil should be half an inch below the rim of the pot, so as to allow of maturing when in growth. The small bulbs should be covered with a little soil.

After potting, stand the pots or boxes outside in the open, on a firm bottom such as a bed of ashes. The pots should be plunged bodily in old turfy soil or leaf-mould, with their tips three inches below the surface. Practically any soil will do if not too wet. This will secure a natural and moist condition to the bulbs and will encourage root action. No watering should be necessary under such conditions. If placed in a warm dry cellar as is sometimes done, watering for a time or two is an advantage. The pots or boxes should remain plunged for a period of about ten weeks, when they may be transferred to a greenhouse or sitting room, where the night temperature does not exceed 55 degrees and the day 60 degrees. However they do fairly well under much higher temperatures. Daffodils do not require much forcing. After the bulbs are out of the plunging bed, give the plants as much light and air as possible, and water when required.

PROPAGATION

It is an established fact that the Narcissi in great variety can be successfully grown commercially in various sections of the United States. At Portsmouth and Richmond, Va., Santa Cruz and Ukiah, Cal., and in other sections the growing of the Narcissi, for cut flowers and for bulbs, has developed into an industry of importance. In Canada we scarcely know how much of the country is suitable to its cultivation, but probably only a very small part. On Vancouver island and on the Pacific slopes of the mainland of British Columbia the industry is developing and the value of the product has been amply demonstrated. The usual method is to take the young bulbs and slabs, plant in the autumn as directed under culture. The bulbs are left in the beds undisturbed for two or three years. When the foliage matures and turns yellow, which under normal conditions is in June or July, the bulbs are lifted, cured and graded. The larger ones are sold, and the others replanted in the fall and treated as before. New varieties arise from seed, often as chance seedlings. We have no doubt but that the chances of obtaining something worth while as chance seedlings, are as great as when the parentage is known, for the parentage is known in any case for one generation only. The young plants produced from seeds require infinite patience for they reach maturity only after several years.

INSECTS

Severe losses are sustained each year through the work of the Narcissus Bulb Fly. There are two species attacking bulbs, viz. Small Narcissus Bulb Fly (*Eumerus strigatus*) and the Large Narcissus Bulb Fly (*Merodon equestris*).

Scorers of larvæ of the Small Narcissus Bulb Fly may be found in badly infested bulbs in the advanced stage. The interior of the bulb is entirely

destroyed and is full of a semi-liquid decaying mass. The attack seems to begin at the neck and in mild cases the larvæ are found in the neck or under the scales at one side. The presence of many larvæ and the complete decay produced distinguishes the damage done by *Eumerus* from that done by *Merodon*. The larvæ or maggot of the small Narcissus Bulb Fly is about one-half inch in length when full grown, is greyish-yellow in colour and has a distinctly wrinkled appearance. The mouth parts are brown and the respiratory process at the front end are brownish red. The adult is about one-quarter inch in length, is blackish-green in colour with white marks on the side.



PLATE 4.—To illustrate larva of small narcissus bulb fly.

The adult of the Large Narcissus Bulb Fly is about one-half inch long and resembles a bee in appearance and actions. The egg is very small, oval in shape and white in colour. The larva or maggot is whitish or yellowish in colour and when full-grown is from one-half to three-quarters of an inch in length. The larvae pupate in the bulb or in the soil nearby. The eggs are reported as being laid at or near the base of the leaves of Narcissi or on the necks of the bulbs when these are exposed. The young larvae bore into the bulb and feed upon the tissues, which they rasp or tear apart by means of strong hooked mouth parts. The bulbs usually become soft, and as feeding goes on rot frequently sets in. In 1925 considerable work was undertaken to control the fly pest.

Plot 1. Bulbs treated with formalin.

Plot 2. Bulbs treated with corrosive sublimate, as for potatoes.

Plot 3. Crude naphthalin scattered under bulbs at planting time.

Plot 4. Bulbs soaked in water for various length of time.

Plot 5. Bulbs soaked in solution of household ammonia.

Notes were taken as to method of treatment and results obtained, as shown in the following paragraphs.

Plot 1. Bulbs treated with Formalin 10 ounces to 24 gallons of water for 24 hours. No external appearance of larvæ. Those soaked for three days showed 1 per cent. This plot was dug over in spring to remove any weak or diseased bulbs and examined for larvæ. The bulbs were found infected to 1.7 per cent. Another plot of double strength, 10 ounces to 12 gallons of water soaked for 2 days, no larvæ. Dug in spring 9.7 per cent diseased and 1 per cent with larvæ.

Plot 2. Bulbs treated with corrosive sublimate. Corrosive sublimate 1 ounce to 9 gallons of water for 6 hours; 1 per cent larvæ appearing. Soaked in water for 7 days 13.5 per cent larvæ emerged; (1.5 per cent *Merodon*, 12 per cent *Eumerus*). Roguing disclosed 5 per cent disease, no larvæ.

Plot 3. Crude Napthaline scattered under bulbs at time of planting. The plot was rogued and 29.7 per cent removed; 1.4 per cent contained larvæ.

Plot 4. Bulbs soaked in water. Bulbs soaked in water for 7 days; that 6.2 per cent *Merodon* appeared and 7 per cent *Eumerus*. A few bulbs had larvæ with heads appearing indicating that a longer period might be beneficial. Plot rogued in spring; 8.3 per cent of weak bulbs removed contained 2.1 per cent larvæ. Special plot soaked in water for 10 days; 9.7 per cent larvæ emerged. No larvæ found in spring.



PLATE 5.—Narcissus bulb fly (right). Lesser bulb fly (left).
(enlarged one-fourth)

(Courtesy Entomological Branch, Ottawa.)

Plot 5. Bulbs soaked in household ammonia, $1\frac{1}{2}$ pints to 9 gallons of water for 24 hours; 4 per cent larvæ emerged. Roguing in spring disclosed 3.3 per cent larvæ.

For the control of the fly at present we recommend the following:—

1. To inspect each bulb before planting very carefully. Those containing larvæ should be sorted out and burned. Infected bulbs may be detected at this time, if they have been out of the ground long enough to become cured. Sound ones are firm and hard while those containing larvæ are more or less soft and pulpy.

2. Before planting soak in cold water for about 8 days. With this treatment many of the insects crawl out of the bulbs and are destroyed. The use of cold water does not appear to injuriously effect the bulb.

3. In the spring when the foliage is about 6 inches high the bed should be gone over and weak sickly plants taken out and burned. In many cases these plants will be infected with larvæ. The flies begin to appear about the second or third week in April. One must rogue early before they escape.

4. The cultivation of the soil during the latter part of March and April may destroy immature flies in great numbers while still in the pupal stage.

The hot water treatment for the control of the fly is becoming more popular, and is here given: The bulbs are immersed in hot water, held at a temperature not lower than 110 degrees F. or higher than 112 degrees F. for a period of at least three hours. Statistical results furnished by Dr. Doucette substantiate the statement that the standard three-hour treatment at 110 degrees F. is fatal to the fly larvæ. His experiments show that a temperature of 100 degrees F. is too low to give complete mortality within three hours. At 105 degrees F. the treatment should last at least two hours to insure complete mortality. One hundred per cent mortality was obtained in all immersions of 40 minutes and longer at 110 degrees F. Where the temperature of the water was above 100 degrees F., viz., 114 degrees, 117 degrees, and 120 degrees, immersions of 30 minutes gave complete control. Two objections have been raised by growers against the method, viz. The difficulty of holding water at a given temperature on the ordinary farm for the proper length of time; and the effect on the bulbs. No doubt the former objection may be overcome. As to the latter, some report injury, others are satisfied if the cooking is done at the right time. We believe that the method is always safe if done while the bulbs are dormant, neither too early or too late (say in August) with the understanding that the bulbs were lifted before they had thrown out new roots, and after they had become mature—as indicated by the foliage.



PLATE 6.—Pupa and adult large narcissus bulb fly. (*Merodon equestris*).

DISEASE

Several rots, etc., are reported but in so far as we have observed them, secondary in nature. We believe that with 100 per cent daffodil fly control, and with correct well drained soil, the danger from disease is slight, as far as this plant is concerned. (See chapter on disease.)

VARIETIES

TRUMPET NARCISSUS

(Distinguishing characters—Trumpet or crown as long as, or longer than, the perianth-segments).

CLASS A. BICOLOUR TRUMPET DAFFODILS

Varieties with white or whitish perianth and a yellow or lemon, or primrose trumpet.

Duke of Bedford. A magnificent flower, measuring $4\frac{1}{2}$ inches across perianth, pure white, broad and of great size, trumpet clear soft yellow.

Empress. Perianth white, trumpet rich yellow.

Glory of Noordwijk. A grand bicour; large yellow trumpet.

Glory of Sassenheim. A good bicour.

Grandee. Perianth white; very large full yellow trumpet; one week later than Empress.

Horsfieldi. Perianth white, trumpet rich yellow.

Josine. An exquisite variety in the style of Mrs. Ernest H. Krelage, but earlier and with a soft primrose trumpet. The shape of the perianth and trumpet is excellent, the former being over-lapping, almost perfect round, and the latter having a very fine edge. The flower has a perfect balance and pose. The perianth is pure white, the trumpet is of a very soft and delicate primrose-yellow, passing into white.

Madame Plomp. Pure white solid perianth, golden yellow trumpet; very large, well-formed and of great substance.

Martha. This variety is superior to the well-known Victoria. Exceedingly fine variety.

Mrs. Walter T. Ware. A perfectly-shaped, very free and early blooming daffodil with pure-white perianth and a well-expanded beautifully curved golden-yellow trumpet.

Spring Spur. Very early bicour.

Silver Glory. Very early, perianth pure white, trumpet gold yellow, lovely scent.

Sulphur Beauty. A splendid daffodil with white perianth and soft citron-yellow trumpet; sweet-scented.

Victoria. Bold erect flower with creamy white perianth and rich yellow trumpet.

Weardale Perfection. Perianth white, trumpet soft sulphur-white; exceedingly handsome.

CLASS B. WHITE TRUMPET DAFFODILS

(Varieties with white perianth and white or nearly white trumpet).

Albicans. Perianth white, trumpet primrose passing into white.

Alice Knight. Perianth white, trumpet creamy white; elegant form, very early.

Duchess of Normandy. A charming early daffodil, with broad slightly twisted pure-white perianth.

Loveliness. A very large flower of remarkable beauty, with bold stiff broad snowy white perianth, and very elegant white trumpet, expanding at mouth; highly recommended.

Madame de Graaff. A beautiful white Trumpet daffodil, perianth pure white, trumpet very pale primrose, passing off pure white; a most refined and delicate flower; strong healthy grower.

Medea. Large flower with a creamy white somewhat twisted perianth, and bold trumpet of the same shade. The trumpet has an exceptionally fine brim and the whole flower is first-class for shape, pose, colour and boldness.

Mrs. Ernest H. Krelage. A very beautiful daffodil of fine form and wonderful substance, wholly white, with faint creamy tint; poised on a stout stem. The $1\frac{1}{2}$ inches-long trumpet is about the same breadth across the finely frilled mouth. The whole perianth has a spread of 4 inches, the outer segments measuring $1\frac{5}{8}$ inches broad. Up till now the best white daffodil ever raised.

Peter Barr. Beautiful bold flower, perianth pure-white, trumpet white; one of the best among the white daffodils.

Snowflake. White perianth, trumpet tinged apricot, passing off pure-white.

White Princess. Soft creamy white trumpet, strong and of great substance, perianth pure white.

W. P. Milner. Splendid free-flowering variety with very distinct pale-sulphur flowers, forces well.

CLASS C. YELLOW TRUMPET DAFFODILS

(Varieties with yellow-lemon or sulphur-coloured trumpet and perianth of same shade or higher, but not white).

Candlestick. A fine daffodil of a uniform soft yellow colour. The flower is of a most regular shape and the straight trumpet on the flat perianth more or less suggests the design of a candlestick. It is a neat flower in every respect, of good proportions, the perianth being round and overlapping, while the pose of the flower is excellent.

Cleopatra. A magnificent variety like *Monarch*, but larger; very broad yellow imbricated perianth and long bold deep yellow trumpet.

Emperor. Perianth deep primrose, trumpet full yellow; splendid grower.

Glory of Leiden. Full yellow; one of the largest amongst the large Trumpet daffodils; poor shipper.

Glory of Haarlem. This noble Trumpet daffodil may be considered an improvement of *King Alfred*. The large flowers borne on long rigid stems open early in April; they are of faultless shape; the widely opened trumpet having a most elegantly frilled brim, is citron-yellow colour and of excellent shape.

Golden Spur.

Henry Irving. Perianth and trumpet golden yellow.

Hope of Holland. A really mammoth flower, but of good proportions, the trumpet being nearly 2 inches long and nearly 3 inches across. It is of a remarkably fleshy substance and produces a quite novel impression. Trumpet and perianth are of a uniform clear yellow. The flowers are borne on heavy long stem.

King Alfred. A remarkably handsome daffodil which we can strongly recommend; flowers of large size, great substance and refined finish; colour uniform clear rich golden yellow; large trumpet of elegant form with open deeply frilled mouth; very tall and vigorous grower and free-bloomer.

Lord Roberts. Grand Trumpet daffodil, flowers of enormous size; golden yellow with broad massive perianth and noble trumpet.

Monarch. A noble flower and one of the most refined of all the golden Trumpets; perianth and trumpet rich full yellow.

Olympia. Deep primrose-yellow twisted perianth; huge trumpet of slightly deep colour; enormous flowers. The largest Trumpet daffodil in existence. Splendid for the garden and magnificent when grown in pots.

Princess. Perianth sulphur, trumpet yellow; very early; fine for flowers and foliage.

Thackeray. An improved *King Alfred*, being a much more vigorous and perfectly healthy grower with broad stiff foliage, 1-inch broad. The flower-stem attains a height of 22 inches, and bears the flower upright. The flowers are of a uniform deep golden yellow and of a most elegant shape, the perianth-segments being twisted and the large trumpet having an exceedingly handsome edge. An early bloomer.

Tresserve. Fine yellow trumpet and perianth of the colour, a very robust and free-flowering variety, producing flowers of enormous size.

Van Waveren's Giant. One of the largest of all Trumpet daffodils. Flowers of immense size; perianth primrose and of Campanulata-form; trumpet bright orange-yellow with a very large mouth, very tall.

INCOMPARABILIS DAFFODILS

(Large chalice-cupped daffodils)

(Distinguishing character: Cup or crown measuring from one-third to nearly equal the length of the perianth-segments).

Autocrat. Soft yellow cup, widely expanded at the mouth; with broad perianth of primrose-yellow, slightly reflexing; handsome free-flowering variety for the border and for pots.

Beauty. Sulphur-yellow perianth, large yellow cup, margined orange-scarlet; bold strong flower; splendid grower.

Bedouin. The flower measures more than 4 inches across and has a large white perianth, broad and spreading; cup large and expanded, glowing fiery orange-scarlet, elegantly fluted and crinkled at brim.

Bernardino. A grand flower with very large creamy white perianth and a very large pale cup; prettily fluted, and heavily stained deep orange-apricot.

Blackwell. Perianth primrose-yellow, cup straight and deeply fluted yellow, heavily stained fiery orange-scarlet; a bold handsome flower, lasting long in condition; excellent for forcing.

Brigadier. Similar to Sir Watkin but of far superior form and finish; pure white perianth with a very large open cup of deep yellow; free-bloomer; a splendid daffodil.



PLATE 7.—Collection of Narcissi. Upper, left to right: Weardale Perfection, King Alfred, Glory of Noordwijk. Lower: Olympia, Van Waveren's Giant.

(Courtesy of U. S. Dept. of Agriculture)

Citronia. A beautifully formed flower, soft citron-yellow, almost a self, with greenish shading in centre of crown.

Gloria Mundi. A grand flower with clear yellow perianth and a broad well-expanded orange-scarlet cup.

Great Warley. A remarkably striking flower after the style of Lady Margaret Boscawen, but very much larger; indeed, the largest Incomparabilis variety yet raised. Perianth white, broad and massive, crown clear yellow, measuring $1\frac{1}{2}$ inches across.

Homespun. Perfectly shaped flower of a soft beautiful primrose-yellow, exceedingly beautiful.

Lady Margaret Boscawen. A bicolour Sir Watkin. Snow white, broad overlapping petals, with large trumpet-shaped crown of deep golden yellow, slightly frilled.

Laughing Water. Snow-white perianth of beautiful form and large open cup of pale primrose, edged deep primrose and beautiful frilled. A flower of great substance and one of the finest daffodils of recent introduction.

Lucifer. Large handsome white perianth, cup intense glowing orange-red; fine early forcer.

Lucinus. A very large variety in this section with very large flat cup; of a very robust growth. Its colour is deep yellow perianth as well as trumpet; especially recommended for exhibition.

Sir Watkin. Perianth sulphur; cup yellow, tinged bright orange; a bold handsome flower.

Sparkler. Very large and showy decorative flower, measuring 4 inches across. Perianth rich yellow, crown very large, fiery orange-yellow and the perianth light yellow.

The President. A flower of huge size and good substance. The cup is orange-yellow and the perianth light yellow.

Will Scarlet. Fiery orange-red, cup very broad and wide open; one of the most striking daffodils; cannot be forced.

BARRI NARCISSUS

(Short-Cupped Daffodils)

(Distinguishing character: Cup or crown measuring less than one-third the length of the perianth-segments).

Albatross. A very handsome flower, perianth white, cup pale citron-yellow, prettily frilled and conspicuously edged orange-red. Beautiful.

Circlet. Sulphur-white perianth with very large overlapping petals, well rounded and slightly reflexing chrome-yellow eye with tiny edge of madder scarlet, quite flat and very regularly fringed and crimped; very beautiful.

Cossack. A remarkably beautiful and striking flower with broad white solid perianth; slightly reflexing cup spreading and of intense dark orange-red.

Dorothy E. Wemyss. Large white perianth; yellow cup, beautifully edged orange-scarlet.

Fair Maiden. Flower large and after the style of Sea-gull, but of better form; perianth pure white, very broad and imbricated; crown open and elegantly fluted yellow with orange-buff margin. Beautiful.

Fire-brand. Perianth creamy white, shaded lemon at base; cup intense fiery red; very brilliant.

Fiery-Cross. Perianth cream-coloured, broad and slightly reflexed; crown wide and expanded, elegantly fluted, brilliant yellow with heavy margin or bright fiery red; very striking and beautiful.

Flora Wilson. Pure white perianth; yellow cup, edged orange-scarlet; a striking beauty.

Masterpiece. A magnificent new daffodil; white petals of perfect form; cup glowing orange-scarlet; exquisite.

Mohican. A sister seedling of Sunrise, which it somewhat resembles; perianth white with yellow radiating from the base; cup suffused almost throughout fiery orange-scarlet; very bright and attractive. Cut flower young to preserve the colour.

Red Beacon. A most lovely daffodil; flower immediately attracts one by its brilliantly coloured cup; the perianth is ivory-white, broad and of great substance, slightly shaded sulphur at base; cup prettily fluted and of the most intense fiery orange-red.

Red Chief. A most lovely attractive flower; perianth solid pure-white, broad and well-imbricated; crown flattish with broad margin of fiery orange-red and prettily fringed at edge.

Royal Star. A remarkably bold and strong flower, perianth cream shaded sulphur and developing to white, crown very large and flat, prettily fluted opening brilliant orange shaded yellow, but soon developing to a most striking fiery orange-red, a good lasting flower.

Sea Gull. Large spreading pure-white perianth; cup canary-yellow, edged apricot; a very good flower among the cheaper varieties.

Saint George. A very lovely exhibition flower with broad rounded creamy white perianth of fine texture and a striking Poeticus-eye.

Torch Light. Perianth pale primrose, broad and imbricated; crown bold and open of a golden orange, shaded fiery scarlet; flower of good form and very attractive.

Village Beauty. Creamy white perianth; large dark yellow cup, edged orange-scarlet.

LEEDSII NARCISSUS

Amazon. A remarkably handsome flower of fine form and great substance, perianth pure white; cup canary; a strong grower and fine bloomer, often coming with two flowers.

Ariadne. A flower of refined beauty and the admiration of all who have seen it; perianth white, cup ivory-white, very large saucer-shaped, wide and spreading, prettily frilled at margin; a striking flower, lasting long in bloom.

Beatrice. Snow-white, remarkably pretty and graceful.

Bianca. A very refined flower, beautiful in form and pure in colour, broad solid white perianth; cup globular and prettily fluted clear lemon with a well-marked dark green eye.

Czarina. The largest and handsomest of the Giant Leedsii; a grand flower of immense size, measuring 5 inches across; broad white perianth, elegantly twisted; very large delicate citron crown, $1\frac{1}{2}$ inches long, with bold open mouth; tall robust grower.

Duchess of Westminster. Large white perianth; long canary-yellow cup, tinged orange, passing off pure white; very beautiful.

Empire. Large white perianth with broad imbricated petals; very large beautiful frilled crown of soft yellow, passing into white with age; on an enormous flower of great substance and refinement, and the finest Giant Leedsii yet raised.

Evangline. Broad pure-white perianth, with smooth overlapping petals of remarkable substance; large citron-yellow cup; a daffodil of great beauty and wonderful form.

Fairy Queen. Perianth pure-white; straight creamy white cup, prettily fluted; strong grower, and exquisite flower of chaste beauty.

Hera. Silvery white perianth; pure waxy-white crown.

Katherine Spurrell. Very broad sulphur-white perianth; canary cup; large well-shaped flower.

Lord Kitchener. Large pure-white perianth, broad and flat, of great substance; crown very large of a delicate pale primrose, well open at the mouth and elegantly crimped at the brim; a flower of perfect quality and considered one of the best in its class.

Maid of Athens. A very beautiful and graceful flower, measuring 3 inches across; perianth white, well-imbricated and slightly scalloped; cup globular sulphur-white with a pretty buff-yellow margin.

Mrs. Langtry. A remarkable free-flowering variety with broad white perianth and large white cup, edged bright yellow.

Peach. Perianth pure-white; crown long and straight and of a lovely apricot-orange.

Queen of the North. Large flower with very broad glistening white perianth and soft primrose-yellow cup, prettily fluted; a flower of the highest quality and colour and one of the most beautiful; specially recommended.

Saint Olaf. A flower of remarkable beauty, measuring $3\frac{1}{2}$ inches across; very broad rounded white perianth, well-imbricated; and a wide flattened crown, very prettily fluted, measuring $1\frac{1}{4}$ inches across, colour cream, delicately margined sulphur, and with sulphur-shaded centre.

Undine. A remarkably beautiful flower; snowy white Campanulata-perianth; crown creamy white, straight and deeply fluted.

White Lady. An exquisite flower with a broad white perianth of perfect form; dainty cup, prettily crinkled and of a beautiful pale canary shade, very chaste.

White Queen. A magnificent flower resembling a white Sir Watkin; a most refined flower and a splendid sturdy grower; free-flowering; specially recommended.

POETAZ NARCISSUS

Admiration. Sulphur-yellow perianth, sulphur-yellow eye, bordered scarlet.

Aspasia. Perianth pure-white; cup yellow, true Poeticus-form; very tall stem.

Alsace. Petals pure-white with sulphur eye, slightly edged reddish.

Elvira. Bearing on long graceful stems heads of 3 or 4 large flowers with broad white petals of great substance and a golden yellow cup, edged orange; delicately fragrant.

Helena Maria. Silver-white petals with yellow cup. Splendid flower and good bloomer. One of the best white varieties.

Ideal. Perianth white; cup dark orange; very large truss.

Irene. Perianth sulphur-yellow; cup orange; very fine flower.

Klondyke. Perianth yellow, cup deep golden yellow; one of the finest and deepest yellows.

Orange Cup. The best yellow; orange cup, edged red; very beautiful.

Orange Globe. Light sulphur-yellow petals with deep orange eye; very distinct variety.

Orient. Perianth silky sulphur-white, bright eye; one of the finest.

Sunset. Sulphur-yellow with orange eye.

Triumph. Pure-white; deep yellow cup; large flower.

POETICUS NARCISSUS

Almira (King Edward VII). Snow-white petals; cup canary-yellow, bordered red; a much better form than *Ornatus*.

Cassandra. A noble and gigantic Poeticus Narcissus of tall strong growth, flowers of fine substance with broad white perianth; cup deeply rimmed dark red.

Dante. Pure-white, earliest of all.

Eagle. New, tall vigorous grower; one of the best varieties for early forcing.

Epic. Large flower; broad solid snow-white perianth; canary cup with striking fiery red margin.

Glory of Lisse. Pure-white, orange centre.

Homer. A splendid broad-petalled Poeticus; very large.

Horace. Broad snow-white perianth; large cup, deeply edged blood-scarlet, very beautiful, one of the best.

Laurette. One of the earliest Poeticus; very large.

Miss Willmott. A fine hybrid Poeticus of exceptional excellence; large massive white flowers, $3\frac{1}{2}$ inches across; crown, which measures $\frac{7}{8}$ inch across, is lemon-yellow, heavily banded with bright orange-red; very free and vigorous grower, also an excellent early forcing variety.

Ornatus. Perianth pure-white and perfect shape; cup yellow, margined scarlet.

Petronella. Perianth white, cup margined scarlet; very large, without doubt the largest Poeticus ever raised; scarce.

Pheasant Eye. (See *Recurvus*).

Queen of England. Snow-white, one of the finest amongst this type; very large and robust.

Recurvus (the old Pheasant Eye). Pure-white perianth; cup deep orange-red; the best for massing and naturalising; one of the latest to bloom.

Sicamoor. Pure-white with yellow eye; one of the best.

DOUBLE NARCISSUS

Albus Plenus Odoratus. Pure-white, sweet scented; gardenia-like flower; a splendid cut-flower, but a shy bloomer the first year after planting; only for outdoor planting; late. To obtain fine handsome flowers these Narcissi should be planted early in a good deep cool soil, not too dry.

Argent. A beautiful cross between *Telemonius Plenus* and *Poeticus Ornatus*, bearing elegantly formed star-shaped semi-double flowers with creamy white petals and yellow centre; strong robust grower.

Campernelle Rugulosus Flore Plena. (See *Jonquils*).

Incomparabilis. Plenus (Butter-and-Eggs). Large double light yellow rose-shaped flowers, orange-coloured towards the centre; very effective in clumps and masses.

Orange Phoenix (Eggs-and-Bacon). Large double rose-shaped flowers, white with rich reddish orange centre; not recommended for forcing on account of its weak stem when forced.

Primrose Phoenix. The large double rose-shaped flowers are of a beautiful soft lemon shade; much prized for vases.

Stella Superba (Butterfly). Perianth white; very pretty double cup.

Sulphur Phoenix (Coddings-and-Cream). Large double white rose-shaped flowers of sulphur centre; very chaste and beautiful; much prized for bouquets, vases, etc.

Van Sion. The large old double Yellow Trumpet Daffodil.

JONQUIL NARCISSUS

Buttercup. Rich buttercup-yellow; a cross between *Emperor* and a *Jonquil*.

Campernelle Odorus Rugulosus. Rich yellow; the single sweet-scented *Jonquil*.

Golden Scepter. Giant *Jonquil*; large deep golden-yellow flowers.

Tenrior. Silver *Jonquil*.

HYACINTH

Though the hyacinth has not been so great a success at the Experimental Station as some other types of spring flowers, yet it is one of the most popular among flower lovers.

ORIGIN AND HISTORY

The original of the cultivated hyacinth, *Hyacinthus orientalis* is a native of Greece and Asia Minor, and is in comparison with the cultivated hyacinth an insignificant plant, bearing only a few small narrow lobed sickly pale blue florets, not unlike our common bluebell. The experiments during later years carried out by the florists, and especially by the Dutch, have so transformed the appearance of the flower that few would suspect that it had descended from the original type above referred to.

The hyacinth was in cultivation prior to 1597 at which date it was mentioned by Gerard. Several single and double varieties are mentioned as growing in English gardens in 1665, while in 1754 hundreds of varieties were catalogued by the Dutch growers. About this time *Gloria Mundi* sold for 500 guilders and *Koning Saloman* for 600 guilders.

BOTANY

The hyacinth belongs to the family Liliaceae, as does the tulip. (See under tulips).

GROUPS AND CLASSES

H. orientalis. Common hyacinth. Leaves 8-12 inches long, thick and green; scape 8-18 inches tall, stout, bearing an elongated and dense raceme; perianth about 1 inch long, the lobes oblong, spatulate, as long as the tube, in many colours, often double in cultivation.

H. amethystinus.—Slender and graceful, with light-blue flowers in short racemes, standing nearly or quite 6 inches high; flowers small, nodding, bell-shaped, with short teeth-like segments. Often found in rockeries.

H. azureus.—Looks like a grape hyacinth, 4 to 8 inches tall. Flowers blue, fragrant, in a dense spike, one inch long, tubular with small teeth; distinguished from the genus *Muscari* by the perianth-segments being flattened instead of incurved.

H. lineatus.—Low, 2 to 4 inches high, leaves 2 or 3 inches, oblong-lanceolate, about equalling the scape; flowers small ($\frac{1}{4}$ inch or less, long) 6 to 12 in a raceme 1 inch long, blue, ascending.

H. fastigiatus.—A delicate species, with very narrow leaves, scape 3 to 5 inches high and shorter than the leaves; flowers few, in a dense cluster, $\frac{1}{4}$ to $\frac{1}{3}$ inches long and light-blue. Looks like the *Scilla verna*.

SOILS

The soil in Holland is well suited to hyacinths, so that Dutch florists have made a specialty of the growth of these flowers for many years. Hundreds of acres are devoted to the culture of these bulbs in the vicinity of Haarlem and bring in a revenue of hundreds of thousands of pounds sterling.

The hyacinth delights in a rich light sandy soil. The Dutch incorporate freely with their naturally light soil a compost consisting of one-third coarse sea or river sand, one-third decomposed cow manure, without litter, and one-third leaf mould. The soil thus renovated retains its qualities for six or seven years, but hyacinths are not planted upon the same place for two years successively, intermediary crops of *Narcissus*, tulips, etc., being taken. A good

compost for hyacinths is sandy loam, decayed leaf-mould, well-rotted cow manure, and sharp sand in equal parts, placed in piles and turned occasionally. Beds filled with this compost will grow the hyacinth to perfection.

For general purpose work, any good garden soil suits, provided it is well drained and dug deeply.

FERTILIZER

As has been pointed out, well decayed cow manure may be used in quantity, but horse manure is not recommended. Bone meal is quite safe. If stable manure is not available the fertility of the soil may be restored, if lost, by means of chemicals and the turning down of green manure.

CULTURE

The hyacinth is at its best in formal beds and borders. These should be planted in September. The ground should be carefully prepared by spading to a depth of 20 inches, so that the roots may pass straight through it, to their free development of twelve or sixteen inches. If the top five inches of soil is spaded out to one side the lower soil can then be easily prepared, and a half-inch of sand spread before the bulbs are placed 5 or 6 inches apart. After the bulbs have been set firmly, the top soil can be spread over and firmed. A protecting cover of a few inches of strawy manure is required in the cold sections, where zero weather occurs. This should be placed ahead of the first hard frost, and be removed in the spring when the danger of severe frost is past. No covering is required on Vancouver island. After the flowering period is past the flower-stalks should be cut out and the plants permitted to ripen. This condition will be known by the foliage having bleached white. The bulbs should be taken up and stored in an airy dry building.

FORCING HYACINTHS

Select, from the varieties named, large, solid bulbs. Do not use unnamed varieties or the low-priced grades for house culture. Good blooms come only from the well-developed, firm, ripe bulbs. The five-inch flower pot is the most useful receptacle to grow the bulbs in. These should be lightly filled, first the drainage material and then a rich compost of garden loam, leaf mould and sand. Press the bulb into the soil and cover, leaving only the tip exposed. After potting is completed all should be buried in a sand or cinder box in a cellar or open ground, care being taken to cover all six inches deep. The pots should be kept covered until they have developed a very strong root growth and a stem an inch above the pot rim. The pots may then be taken up and gradually brought to the light and heat, care being taken at first to let the stem assume a good, healthy green before moving to a bright window. Ample moisture should be applied to the soil and a frequent syringing of the entire plant will be beneficial. Bulbs so forced are practically exhausted and have little further value.

CULTURE IN GLASS

The following varieties of single hyacinths are suited to water, wet moss, or fibre culture: Grand Lilas, King of the Blues, Macmahon, Moreno, L'Innocence, La Victoire, Lord Macaulay, Lady Derby, Mina, Grand Maitre, Schotel.

Secure the best quality bulbs of any of these listed varieties and also secure the required number of bulb-glasses. Fill the glass nearly full of pure water up to a point where it will reach to within one-quarter of an inch from the base of the bulb, drop a small piece of charcoal into the water. Set the bulb-glasses, with the bulb in position, away in a dark closet for a period of eight or ten weeks, or until the lower portion of the glass is well filled with

roots and the flower stalk has made two inches of growth. Water should be added from time to time to replace that lost by evaporation, but do not have the base of the bulb in the water. The move from darkness to bright light should be gradual, and a temperature of sixty degrees will be most satisfactory for water or moss culture. Bulbs forced under this system are exhausted and of no further use.



PLATE 8.—Daughter bulbs arising from “scooped” mother bulbs.

HARVESTING

Under “harvesting” little further need be said. At digging time the slabs should be separated, and the bulbs graded into three classes, according to size. During the drying period, the building should be airy, warm and so arranged that the bulbs should not receive the direct rays of the sun.

PROPAGATION

Hyacinths are propagated naturally either by slabs or by seed; artificially by bulblets secured either by means of scooping or scoring mature or so-called mother bulbs. Slabs are produced to some extent by bulbs under ordinary cultivation each year, but the greatest production is obtained from overmature bulbs. The time to produce mature bulbs by this method is from two to four years, depending upon variety and growing conditions—hence the method is not used to any extent commercially. The growing of hyacinth bulbs from such requires from five to seven years to produce a first-grade size bulb, while the variation among them would be very great. The scooping method in hyacinth propagation is the most satisfactory. More bulblets can be secured by this method and more quickly than by any other. The scooping method is practised as follows. Select only the best matured bulbs, scoop out with a sharp knife or a scooping machine the base of the bulb so as to expose the lower part of the scales, just where they unite with the base. The cutting out of this portion destroys the growing point. After scooping, the bulbs are laid one tier deep in shallow trays and placed in the sun for a few hours to dry the cut surfaces. When the cut surfaces have been relieved of any surplus moisture, the trays of mother bulbs are then placed in a propagating frame or house, where the ventilation, light, moisture and temperature are under reasonable control. A temperature of from 80 to 90 degrees F. is most satisfactory. If excess moisture appears or the scales do not dry and callus quickly, a dusting of ashes or air slaked lime over the cut surfaces will be an aid to drying. In drying, the scales separate slightly and numerous small bulblets start to develop. Under favourable conditions a mother hyacinth bulb, scooped in July, will produce twenty or more bulblets by October, varying in size; some will be as large as a bean.

The mother bulbs with the crop of bulblets attached are planted out in beds of well prepared sandy soil. Beds three feet wide are most satisfactory. The mother bulbs are set base up in rows eight to twelve inches apart and covered four inches deep. They are left in this position until June of the following year, when they are taken up, separated and sorted over according to size, cured and held for replanting in September or October.

The replanting and taking-up-to-cure process is practised each year until the bulbs reach marketable size. In districts where the summer period is very dry the small bulbs are planted in trenches and left in the soil for three or four years.

The scoring method differs from the scooping method in that, instead of removing a large portion from the base of the bulb, cross cuts are made sufficiently deep to destroy the growing point. Other than in the cutting process the bulbs are treated in exactly the same way. With both scooped and scored bulbs, conditions are created that favour the attacks of fungus, so care should be taken to watch every detail and protect the bulbs from dampness, cold, heat, and fungus-spores. If the cut surfaces are sufficiently dried by sunlight and then sprinkled with dry ashes, fungous attack will be reduced to a minimum, providing, of course, that the bulbs are kept in a well ventilated propagating frame or house during the period when the bulblets are forming on the edges of the exposed scales. Keep at a temperature of between 75 and 90 degrees F.

Cutting the bulb in the manner described destroys the growing point and flower-bud, and all the latent strength of the bulb that otherwise would have entered into the production of the plant is used up in the production of baby bulbs. If the mother bulbs are scooped soon after harvest, say in July, they should produce a fine lot of bulbs by planting time.

Scoring results in fewer but stronger bulblets. Two or more cuts are made across the base of the bulb, depending upon its size, and extending to about its centre. The effect on the bulb is to kill the flower and growing point as in scooping.

The stock mother bulbs, intended for "scooping" and "scoring" are carefully grown, rogued for disease, etc., and not permitted to come into full flower, thus the strength of the plant that normally is used in the development of the seed is forced into the development of the bulb. The larger the bulbs, other things being equal, the better the results from scooping and scoring.

The scooped and scored mother bulbs with bulblets attached are planted in beds of any desired length and about three feet wide. The planting is usually done bottom side up, but base side down is satisfactory, in some cases at any rate. The bulbs should be planted about four inches apart in the row and the rows six inches apart, and covered with four inches of soil. By harvest time the mother bulb will have disappeared, and in its place will be found a cluster of baby bulbs. These are dug, dried, sorted and planted as before recommended.

SCOOPING VS. SCORING BULBS

Four varieties of tulips, three of daffodils and three of hyacinths were selected for this experiment where scooping and scoring were tested.

The tulip and daffodil bulbs averaged one ounce in weight, while the hyacinth bulbs averaged less than three ounces. Twelve tulip bulbs were used in each method, while but six of each of the varieties of daffodils and but three of hyacinths were tested.

All scoring was done with a knife, from four to six cuts being made in the bulb according to size and shape. The scooping of the tulip and daffodil bulbs was done with a drill, while a knife was used for the same operation on the hyacinth bulbs. After scooping and scoring, the bulbs were set in moist sand in cold frames where they remained for 119 days, July 19 to November 16. At the end of this period they were lifted, the increase of bulblets were counted and then reset in the field to develop. The scoring process gave the greatest increase of bulblets with tulips and daffodils, while scooping gave the largest increase with hyacinths.



PLATE 9.—Scored and scooped hyacinth bulbs. Scored at left, scooped at right.

SCOOPING VS. SCORING

Variety	Treatment	Increase in bulb- lets per bulb
<i>Culip Duchesse de Parma</i>	Scooped.....	5
“ “ “.....	Scored.....	16
“ <i>Chrysolora</i>	Scooped.....	7
“ “ “.....	Scored.....	12
“ <i>Picotée</i>	Scooped.....	3
“ “ “.....	Scored.....	9
“ <i>La Candeur</i>	Scooped.....	9
“ “ “.....	Scored.....	35
<i>Daffodil Frank Miles</i>	Scooped.....	16
“ “ “.....	Scored.....	38
“ <i>Horsfieldi</i>	Scooped.....	10
“ “ “.....	Scored.....	20
“ <i>Incomparabilis</i>	Scooped.....	11
“ “ “.....	Scored.....	32
<i>Hyacinth, Madame Van der Hoop</i>	Scooped.....	32
“ “ “.....	Scored.....	20
“ <i>Enchantress</i>	Scooped.....	57
“ “ “.....	Scored.....	14
“ <i>King of the Blues</i>	Scooped.....	80
“ “ “.....	Scored.....	24

INSECTS AND DISEASES

INSECTS.—The insects attacking *Narcissi* may be looked for on hyacinths. They are usually found there, and may be associated with other insects feeding on the decayed tissue resulting from disease.

DISEASE (see chapter on disease).—At this Station, soaking the bulbs before planting in formalin (2 ounces, to water 3 gallons) for 4 hours has been found of use in controlling disease.

VARIETIES

RED AND ROSE

Beauty. Brilliant pink; large elegant truss; medium early.

Etna. Bright dark rose; large fleshy bells, forming a beautiful and big truss on a strong stem. Splendid for growing in pots and for bedding, if planted by itself. Blooms after all other hyacinths are gone.

Garibaldi. Deep crimson-red. One of the most popular varieties in Europe for early forcing.

General De Wet. Pink Grand-Maitre. Blush-pink; large; fine for pots.

Gertrude. Dark pink. The most popular pot and bedding hyacinth.

Gigantea. Blush pink. An old variety, but still popular. Largely used in miniature size for cutting. Very small bulbs produce flowers.

Hofgartner Kunert. Bright rose with lighter centre. A very attractive colour, especially when forced.

Jacques. Pale rose; the largest spike among hyacinths, a real giant, but has to be shaded a little when forced to get the right colour.

Lady Derby. Clear rose-pink. One of the leading pot hyacinths, owing to its perfect spike on a strong stem, and its splendid forcing qualities.

La Victoire. Bright carmine-rose, when forced a fine dark pink. This hyacinth is the very best in this colour, unsurpassed for pot plant, and for bedding purposes.

Lord Balfour. Bright rosy red with a strong stem. A big improvement on *Moreno*.

Marconi. Bright deep rose, flushed white; large compact spike; one of the finest novelties. Specially recommended for collection.

Nimrod. Deep rose, very beautiful, the earliest of all pink hyacinths. The bulb is small, but produces a handsome spike with small closely arranged bells.

Panama. An improvement on *Lady Derby*; larger spike and more in bright pink.

Queen of the Pinks. Very lively pink, large spike. A sport of *King of the Blues*, but should not be forced early. Regarded as the best pink in existence.

Victor Emmanuel. Pale pink, striped bright crimson; large compact spike; early.

WHITE

Arentine Arendsen. Snow-white. Specially recommended for early forcing.

Correggio. Snow-white, large fleshy bells of great substance; large compact spike. Late; extra for pots. Best white in existence.

Hein Roozen. The big snow-white bells form a long loose spike of great elegance. A very early forcing variety and superb for bedding.

La Grandesse. Snow-white. Should not be forced after the middle of March because the stem grows too tall after that time. Largely used in miniature size.

L'Innocence. Pure-white, with large bells of great substance. One of the best for forcing and bedding.

Madam Kruger. Snow-white; very beautiful and worth a trial.

Princess Juliana. The latest creamy white hyacinth; perfectly shaped truss; unusual large bells.

Queen of the Whites. Pure-white sport of Queen of the Blues. Large well shaped truss. The best late white bedder.

White Lady. Immense pure-white hyacinth with compact spike. A sport of Lord Derby.



PLATE 10.—Chionodoxa—"Glory of the Snow".

BLUE

Admiral Courbet. Bright sky-blue; enormous truss; early forcer. Has to be shaded a little when coming in bloom, to get the bright sky-blue colour.

Bismarck. One of the finest light-blue hyacinths; enormous truss; one of the earliest.

Czar Peter. Light lavender-blue, enormous spike with large waxy bells. One of the oldest varieties, but one of the finest.

Dr. Lieber. Pale lavender-blue, with faint tinge of dark violet; large well-filled spike; early forcer.

Enchantress. Most delicate porcelain-blue. One of the best blue hyacinths; extra for pots.

General Van Der Heyden. Dark grayish-lavender-shaded mauve; beautiful white-eyed bells of the finest porcelain-blue; medium-sized spike.

Gounod. One of the largest flowers of a glittering porcelain shade; undoubtedly the best porcelain in existence. Especially recommended for exhibition purpose.

Grand-Maitre. Deep lavender-blue, shaded dark blue. The most popular blue. Forces splendidly and is a great bedder.

King of the Blues. Rich dark blue, one of the largest flowers existing. Excellent for late forcing and bedding.

Lord Derby. Silvery lavender-blue; large compact spike of great beauty and size. Splendid for forcing and any outdoor purpose.

Menelik. Deep black-blue. One of the best of the very dark blue hyacinths. The colour is glittering bluish black. The spike is large and well formed.

Myosotis. Gigantic flower of forget-me-not-blue; a very fine hyacinth and one of the best in this list.

Paul Kruger. Porcelain-blue. One of the largest flowers in this colour. Fine for exhibition purposes.

Queen of the Blues. Very light porcelain-blue. In miniature is this variety largely used and is the best blue for this purpose. Large bulbs often produce green-tipped flowers.

Schotel. Soft light blue; long perfect truss. Easy forcer and splendid bedder.

Zulu King. The darkest purple-blue. One of the earliest hyacinths for forcing; latest novelty.

Lord Balfour. Lilac-rose, tinged dark violet; enormous truss; very early; the best in this colour.

Sir William Mansfield. Purplish violet; large spike; a variety recommended.

Queen of the Violets. Purplish violet. Sport of King of the Blues.

YELLOW

City of Haarlem. Golden yellow, the grandest flower among the yellows. The colour is of the purest golden yellow, and the truss is large and well formed.

King of the Yellows. Rich deep yellow; one of the best in its colour.

Prince Kendrick. Light yellow, large well formed truss. Extra. The most beautiful yellow hyacinth ever raised.

Yellow Hammer. Golden yellow; has the shape of a hammer, hence the name. Splendid early forcer.

FREESIA

The Freesia is not a true bulb, though closely related to the plants previously mentioned. For autumn planting and winter blooming they flourish with less care than many other house plants. Quite recently the plants have become popular with florists as well as with the housewife, for they only have to be known to be loved.

Freesias after planting may be moved into the light at once, for they root readily without the cool storage conditions essential to the best success with many bulbs.

Under good care the plants should be in flower in about twelve weeks from planting time. Since they may be planted over a long period, freesias may be had in bloom from Christmas until June. After flowering, the plants may be dried out gradually and the soil shaken from the roots. They may be replanted the next year, but the resulting blooms will not be so large or fine as those arising from corms not previously forced. When the plants are growing they should be kept cool and moist. The plants may be propagated either by seeds or offsets.

SCILLA

Blue, Wild Hyacinth and Squill are common names applied to this most desirable of very early bulb plants. They are especially valuable for wild or

rock garden planting. The bulbs should be planted in areas where they can remain for a number of years. Very little care is required other than a top dressing manure every third year. *Scilla* can be grown on lawns or under trees and shrubs quite successfully, provided the foliage is permitted to mature. As a house plant they may be forced successfully and they are a valuable addition to any flower window. Plant the bulbs two inches apart in pots or pans, using the methods of growing as given for tulips. *Scilla sibirica* and *Scilla bifolia* are the earliest to flower and generally the most desirable.



PLATE 11.—Snowdrop.

CROCUSES

The first flower to herald the coming of spring is the bloom of the crocus. It is hardy, requires little attention after being planted, and will bloom for a number of years if not destroyed by rodents. Lawns, beds and borders can be planted full of crocuses without interfering with other plants. They bloom so early and are out of the way before other plants generally awakened to spring life. The crocus is not a true bulb, but cormous plant.

A well-drained sandy soil area should be selected for crocus-growing. Clays and soils containing animal manures are not satisfactory. Plant two inches apart where mass effect is desired, in borders, or at a greater distance if naturalizing. Set the corms four inches deep. It is important that the corms should be set four inches deep as the new corm or increase forms on the top or sides of the old one and there is a tendency to work out of the soil after a few years. If the increase is so great as to cause crowding, the corms can be taken up any time after ripening, graded, and reset. Seeds form at the surface of the soil and may be used to produce more corms. The seed should be exposed to freezing and then germinated in flats or pans. It takes three

years to produce a good grade of crocus corm. The autumn-flowering crocus varieties are not generally satisfactory, due to tenderness of the bloom and varying time of cold weather. Of the autumn-flowering crocus the *Crocus speciosus*, *Crocus sativus*, and their varieties, are most satisfactory.



PLATE 12.—Crocus.

MUSCARI

The grape hyacinth is an early flowering bulb that has proven very useful for planting on banks, in rock gardens and on borders. The purple and white varieties have been proven to be very thrifty in the coast districts, persisting for many years if left undisturbed. Close or mass planting should be practised; setting the bulbs not more than two inches apart, and four inches deep. This has been found to be very satisfactory, and gives room for bulb increase. If crowding occurs the bulbs can be taken up, the offsets separated and reset. As a pot or house plant the muscari is very interesting. The bulbs can be forced successfully and many pretty combinations of colours had by arrangement of bulbs at planting time. The forcing method is the same as advised for tulips.

COMMON BULB DISEASES

By F. L. DRAYTON*

While the growing of bulbs of all kinds has been a favourite occupation of the amateur gardener for a long time, their commercial culture, as far as Canada is concerned, is not yet very extensive. In recent years, however, considerable interest has been manifested in the raising of Gladioli commercially, and, to a lesser extent, of tulips, Narcissi, and hyacinths. It would

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seem desirable therefore, at this time, to issue a warning to intending growers that at the very outset they must take every precaution to keep their plantations free from destructive diseases. It is immaterial what kind of bulbs are to be grown, above all things it is essential to refrain from planting a bulb of any kind that is affected with disease, or in a condition readily recognizable as not likely to produce a sound plant. The diseases of ornamental plants have by no means received as much attention as the diseases of plants of more general agricultural or horticultural importance, and there is no doubt that quite a number of bulb diseases have not yet been studied; therefore the above recommendation should be regarded as a fundamental one to successful bulb culture.

When a new industry of this kind is contemplated, many lessons in regard to cultural methods may be learned from countries which have successfully conducted intensive operations along the same line for a number of years. While personal observations have revealed a number of bulb diseases which are likely to be of importance in Canada, we find that little information is available on methods of control of these diseases, literature on this subject being insufficient and scattered. In a good many cases nothing has been done to check their ravages, even in essentially bulb-growing districts, evidenced by the large amount of diseased material intercepted by the plant inspection service of this Department in foreign shipments of bulbs of all kinds offered for admission into Canada.

During the past few years, the Division of Botany has commenced specific researches into the cause and prevention of diseases affecting bulbs, corms, rhizomes, etc., of ornamental plants. The results obtained so far from our own studies of the diseases of the tulip, *Narcissus*, and hyacinth, together with the results obtained by other investigators are here presented for the guidance of the Canadian grower.

DISEASES OF TULIPS

Under proper cultural conditions, careful handling, and by the strict observation of simple precautionary measures at harvest and in storage, the tulip is fairly free from diseases.

Poor storage conditions, essentially lack of ventilation, cause many bulbs to become mouldy. Some indeed may be killed, while others at the best will give rise, on planting, to but poor and weakly plants. This condition we do not regard as a disease in the true sense, yet severe losses are often incurred in this way. Equally when moisture conditions in the bulb-house become excessive, or the bulbs are piled in thick layers, or have been mechanically injured, the resulting plants are not likely to be healthy or yield normal flowers. Poor soil drainage also may result in the injury and death of the bulbs, either no growth taking place in spring, or it is late and lacks in vigour. On examining such bulbs, they are usually found to be covered with common moulds. These again cannot be regarded as diseased conditions.

The symptoms of all diseases which have proved destructive should be thoroughly known by every bulb-grower, so that he may take the necessary precautions to prevent the introduction of diseases into his plantations.

The following suggestions are of fundamental importance to the production of a healthy crop:

1. Clean cultivation; thorough aeration of the soil by good and frequent cultivation of the soil, and of the plants by the control of weeds.
2. Avoid successive plantings; do not plant bulbs in the same land oftener than once every three years.
3. Sanitation; the destruction of crop wastes and refuse.
4. Annual lifting of the bulbs.
5. Care in harvesting and storing.



PLATE 13.—The Grey Mould Blight of Tulips (*Botrytis Tulipæ* (Lib.) Hop.)

- Fig. A—A diseased plant showing sclerotia encrusting the surface of the bulb.
 Fig. B—A plant killed early in its growth, showing the distortion of the leaves and production of grey mould spores at the base of the leaves.
 Fig. C—A skinned affected bulb showing a disease lesion on the white bulb scale.
 Fig. D—An affected petal.
 Fig. E—Dormant diseased bulb.
 Fig. F—Lesions on the flower stalk.

GREY MOULD BLIGHT OR FIRE DISEASE

(Botrytis Tulipae (Lib.) Hop.)

This is probably the most common and widely prevalent disease to which the tulip is subject.

Plate 1 clearly shows the symptoms by which this disease may be recognized. On the leaves occur small, yellowish, slightly elongated, sunken spots, surrounded by a darker green, water-soaked area giving the leaf a speckled appearance if severely present. These spots may enlarge and unite; their colour changes to a greyish white with a brownish tinge. Wrinkling and twisting of the leaf often occurs, especially when the infection takes place near the margin (Plate 13, Figures A and B). On the flower stalks (Plate 13, Figure F) similar spots appear, though slightly more elongated and depressed. In the flower, a very conspicuous spotting occurs (Plate 13, Figure D), being most conspicuous in the red varieties. These spots are at first minute and whitish to light brown, the colour being bleached from the petals. Later the petals may become dry and wrinkled and the whole flower appears conspicuously blighted.

In these spots develop innumerable disease spores capable of producing more spots on the same and neighbouring plants. When this stage is passed compact bodies formed of the mycelium of the fungus and called "sclerotia" become visible. These are black in colour when mature and about one-sixteenth of an inch in diameter. They are found on the brown outer skin of affected bulbs (Plate 13, Figures A and E) and on the old dried flower-stalk. When the shell is removed, spots are often found on the outer white bulb scale and in a dormant, unskinned bulb, these may easily escape notice. One typical lesion of this kind is illustrated with a faint circle around it, in Plate 13, Figure C. These lesions are usually circular and depressed, with a definite margin which is somewhat raised, and may have a few, small, black sclerotia on their surface. They rarely extend into the bulb, but on removing the outer scales, it will be found that they penetrate to the inner surface of the outer scale.

Humid conditions and the presence of decaying organic matter, such as fallen petals, leaves, etc., are conducive to the disease. There is some difference in varietal susceptibility; on the whole late varieties are more seriously attacked than early.

This disease cannot be cured, but is readily prevented by observing the following precautionary measures:

1. Affected plants, bulbs, and the soil surrounding them should be removed as soon as noticed, as the sclerotia remain in the soil ready to infect succeeding bulbs planted the following season.

2. For this reason tulips should not be grown on the same land in succession.

3. On harvesting the bulbs and during storage they should be handled with care to avoid injury, and be periodically examined so that affected ones can be destroyed.

4. The bulbs should be stored in as cool a room as possible with adequate ventilation.

In Plate 14 other types of lesions are illustrated, which must not be confused with the true grey mould lesions. These are the result of the common blue mould or *Penicillium* rot. The lesions on the bulb in the upper right hand corner of Plate 14 somewhat resemble those of the grey mould blight, but they are more irregular and do not bear sclerotia. The frequent occurrence of a green mould under the bulb scale also serves as a distinguishing feature.

BULB ROT

This is caused by the fungus *Rhizoctonia Tuliparum* (Kleb.) Whet. et J. M. Arth. It has been known for a long time in Europe, but has since been found wherever tulips are grown. It is of some importance, but apparently not as destructive as the grey mould blight.

The first indication of the presence of this disease is observed in spring; planted bulbs either fail to grow or produce a plant which is stunted and soon dies. The bulbs when taken up are, in most cases, well rooted, but there is more or less dry decay beginning at the nose of the bulb, and the healthy white tissue is turned a greyish or reddish grey colour, which is the distinctive feature of this disease. The leaves and flower-shoot, if they have started, have rotted away often involving the adjacent bulb scales. The soil clings to the rotted areas of a diseased bulb, on account of the growth of the fungus into the soil. Loosely attached to the surface of the diseased tissue, embedded in the soil or between the rotted bulb scales, more or less globose and brown to black sclerotia are found. These vary in size from $\frac{1}{16}$ to $\frac{1}{4}$ inch in diameter. A felty layer of the mycelium of the fungus is present between the diseased scales.



PLATE 14.—Blue mould decay of tulip bulbs after storage and transportation.

As affected bulbs are usually completely destroyed by harvest time the disease is not of frequent occurrence in foreign shipments, which undoubtedly accounts for its comparatively rare occurrence in Canada. When present however, the commercial grower should bear in mind, that the organism causing this disease is a soil-contaminating fungus maintained from year to year by its sclerotia resting in the soil. The initial infections may occur in the fall and early winter, shortly after the bulbs are planted, or in the early spring. It apparently spreads slowly from the point of infection and may become serious only when tulips are planted continuously in the same soil.

In the control of this disease the following line of action should be adopted:

1. Diseased plants should be removed with the soil immediately surrounding them.

2. A strict three-year rotation of crops should be observed.

3. The following treatments of diseased areas have been found effective by Messrs. Whetzel and J. M. Arthur in the United States: (a) The application of a solution of formalin at the rate of 1 to 1½ pounds of formalin to 5 or 6 square feet diluted with enough water to wet down to 6 to 8 inches of loosely spaded soil; (b) In small areas, steaming the soil by the inverted pan method has also proved to be successful in exterminating the fungus.

BREAKING

Changes in the arrangement of the colouring of tulip flowers have been observed almost as long as tulips have been cultivated. When the bulbs from such plants are propagated vegetatively from the offsets, the abnormal markings and colourations are perpetuated, and some of them are sold as a distinct race, which are termed "Rembrandts," when the change has taken place in a variety of the Darwin section. They are generally known as "broken" tulips, because the phenomenon was formerly thought to be a genetic reversion. Plate 15, Figure B. illustrates the petals of a "broken" specimen of the Cottage tulip (*var. Grenadier*) and indicates the peculiar variegated or mosaic pattern of the floral colouration. In a less spectacular way the same peculiarity extends into the leaves of this plant in an indistinct pattern showing varying intensity of green colouring matter. There was also a noticeable dwarfing of the plant as compared to normal ones of the same variety. One is struck by the similarity of these symptoms with those occurring in tobacco plants affected by the mosaic disease. Two facts which point to the possibility of this breaking being really a virus disease of the mosaic type are reported by David Griffiths in the United States Department of Agriculture, Bull. 1082. One is that seedling stock from broken strains are free from this abnormality, and that at Bellingham, Washington, where 250-300 varieties of tulips have been grown for fifteen years without the inclusion of any broken types, the plants have never broken. He suggests the possibility that like other mosaic diseases the trouble may be transmitted by aphids.

In view of this information it is advisable for growers to refrain from introducing broken stock into their plantation, for when self-coloured varieties become broken, they can only be sold in a mixture. If broken types are planted they should be segregated at some distance from the other varieties.

BLINDNESS

Plate 15, Figure A illustrates the condition well known to tulip-growers, which is characterized by the growth of one large leaf with the absence of flowers. It is prevalent where bulbs of small size are used. Bulbs which have bloomed well the previous year may become blind the second season.

The definite cause of this trouble is unknown but the following are undoubtedly contributing factors.

1. Slight heating in the pack during transit.
2. In forcing, too high a temperature at the time of rooting.
3. Improper handling after the bulbs are dug.

NARCISSUS DISEASES

The few parasitic diseases of the Narcissus, which have so far been described, are treated in detail later in this section. On the whole the most serious losses are due to improper conditions of culture and handling. The following factors which have a direct bearing on the health of Narcissus plants may be found useful.

1. It is impossible to grow vigorous plants in soil which has a subsoil so impervious that the roots are in stagnant water during the wet season.



PLATE 15—Fig. A, "Blind Tulip." Fig. B, The petals of a broken cottage tulip of the variety Grenadier.

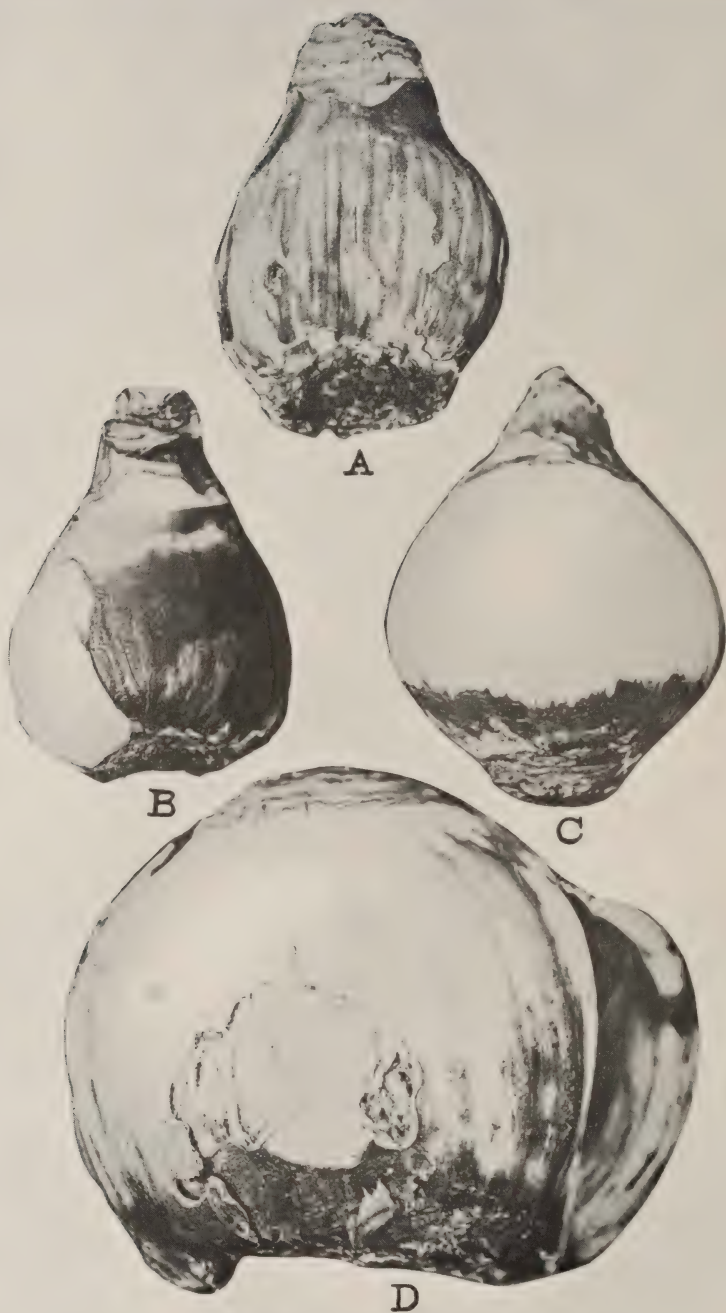


PLATE 16.—Figs. A, B, C types of narcissus bulb decay which are probably secondary to eelworm injury. Fig. D. A decay of Chinese sacred lily bulb caused by *Rhizopus nigricans* Ehr.

2. The use of raw manures is decidedly injurious.

3. Improper storage conditions which result in heating or bruising will frequently produce a decay of the bulbs.

4. When bulbs are dug before maturity and are thrown in piles which are infrequently turned, over exposed, or bruised in handling, a high percentage of valueless bulbs will result. Excessive drying is less injurious than poor aeration with accompanying heating.

5. The frequency with which the bulbs are dug is also a factor which affects the health and vigour of *Narcissus* stock. Considerable rejuvenation apparently takes place when bulbs are left undug for a number of years. Where the dormant season, however, is hot and wet, annual digging is imperative, but where conditions are more suitable, digging every two years will probably yield the healthiest bulbs.

6. Where the winters are severe, freezing may result in dwarfed plants with premature yellowing of the leaves and discolouration of the bases of the bulbs eventually giving rise to a decay. Under these conditions deeper planting and mulching may be necessary. There should not be less than four inches of soil over the bulb and in exposed positions this depth may have to be increased.

EELWORM DISEASE OF NARCISSUS

This is the most important disease of *Narcissus* bulbs. It is also known as the "old disease," "*Narcissus* disease," or "ring disease." It is caused by a bulb nematode or microscopic eelworm, known as *Tylenchus devastatrix* Kühn in England. In Europe this disease has caused considerable loss; so far in the United States it has been of less significance, no doubt on account of the possibility of a longer rotation of crops.

During the blooming season, the injury from this disease is most apparent in the leaves and flower-stems by their distortion. As compared to healthy plants the leaves are stunted, more or less prostrate, and twisted, with irregular margins, and characteristic thickened specks which may be felt, on drawing the leaves or stems between the fingers, as a lump within the tissues, and although it may be nearer one side, it can be felt from both surfaces. Later the tissue of the leaf over the centre of the spot may dry out, crack, and become brown in colour with a light yellow area surrounding the spot. In the bulbs one or more of the scale leaves show a distinct brownish colour and when the bulb is cut horizontally these will be evident as brown rings. When teased out and examined under the microscope this brown tissue is seen to be full of eelworms in all stages of development. Bulbs may be so badly affected that the embryo flower is attacked and when these are planted, if any growth takes place, the leaves would be yellow and twisted in all directions. On the other hand a bulb may be so slightly affected that its first year's growth would be quite normal, but in subsequent years the symptoms would become more pronounced. There is however no evidence to prove that the eelworms can migrate from diseased to healthy bulb scales during the storage period.

The active life of the eelworm occurs in the spring as the weather becomes warm. When diseased bulbs are planted, infection apparently occurs on the young leaves as they push through the soil and they then pass down this to the corresponding bulb scale. It often happens, however, that all the leaves and bulb scales are involved. It is common to find one badly diseased plant surrounded by others showing leaf specks only. Such local infestations spread more rapidly when the Dutch bedding system of planting is adopted than when the bulbs are planted in rows fifteen inches apart and cultivated by hand-operated cultivators, although infestations may extend from one row to another.

In an infected field you will find all the following degrees of infection in the plants:

- (1) Bulbs dead and producing no growth.
- (2) Plants stunted and dwarfed.
- (3) Leaves of normal length but twisted and thickened.
- (4) Leaves with a few specks and no ring discolouration with bulb.

A decay of narcissus bulbs was described in England as caused by the fungus *Fusarium bulbigenum* Cooke et Mass. and is frequently found in shipments of imported bulbs (Plate 16, Figures A, B, C), but of recent years it has been shown that, while the injury from this fungus is extensive, it is not a primary parasite but follows eelworm injury to the bulb.

CONTROL.—1. The living eelworms in an affected bulb may be killed by means of a hot-water treatment. This is done by heating the water in a tank with steam and in this is suspended another tank in which the bulbs are placed in water which is maintained at a temperature of 110° F. for 1½ to 3 hours depending upon the size of the bulbs. It has been found that, when the bulbs are thoroughly cured, it is more difficult to kill the eggs of the eelworms, and, although there is a possibility of some injury to the bulb when they are treated immediately after being dug, it would seem from the experiments conducted by the California State Department of Agriculture that good results were obtained by doing the treatment immediately after the bulbs were dug. They should, however, be thoroughly ripened and should not be cooled too rapidly after the treatment is completed, as this may result in injury to the dormant flower bud.

2. When sickly deformed yellowish leaves are seen in the field no time should be lost in the removal of such a plant with the soil immediately surrounding it.

3. Rigid rotation should be practised.

4. In severe infections the leaves should be cut off at the surface of the ground, collected, and burned. This will check the development of the bulbs, but they will recover during the next year's growth, and after that they should be dug and subjected to the hot-water treatment.

5. Infected land should be carefully avoided for future planting of any bulbs for 3 to 4 years, and every precaution observed to prevent the transference of soil from this area to unaffected parts of the field by cultivating tools or other machinery or by the feet of men and animals.

6. New importations of bulbs should be planted in separate areas and be included in the general stock only when they have shown themselves to be quite free from disease. If it is possible to obtain bulbs which are certified to have been treated with hot water, it is advisable to do so. Every precaution should be taken to prevent the introduction or spread of this pest and when plants or bulbs are suspected of being infected it would be well to have them examined by submitting a specimen to the Division of Botany.

NARCISSUS BULB ROTS

Several different types of decay found in imported *Narcissus* bulbs are being studied at the present time. One, which is apparently of most importance, is caused by the fungus *Botrytis narcissicola* Kleb. Plate 17 shows the appearance of affected bulbs as they arrive in foreign shipments and the type of plants obtained from affected bulbs.

The scales of the affected bulbs show large numbers of sclerotia, $\frac{1}{16}$ inch across and smaller, others are joined together into elongated masses $\frac{1}{2}$ inch long. Such bulbs when planted rarely produce flowers, the leaves soon turn yellow and wither.



PLATE 17.—Narcissus plants and bulbs affected with a disease caused by the fungus
Botrytis narcissicola Kleb.

Imported bulbs should be thoroughly inspected and those having sclerotia should be destroyed. The sclerotia are not always found on the outer paper scales, but more often between the bulbs in a group of divisions.

Plate 16, Figure D, illustrates a decay frequently found in imported Chinese sacred lilies. It is caused by the fungus *Rhizopus nigricans* Ehr.

It is not an active parasite, but follows some mechanical injury to the bulb when placed in storage or during transportation.

A MOSAIC-LIKE DISEASE

This trouble is occasionally found in *Narcissus* plants. Plate 18 illustrates some leaves taken from the *Incomparabilis* variety *Lucifer*. The green colouring matter in the leaves is unevenly distributed causing a streaked appearance

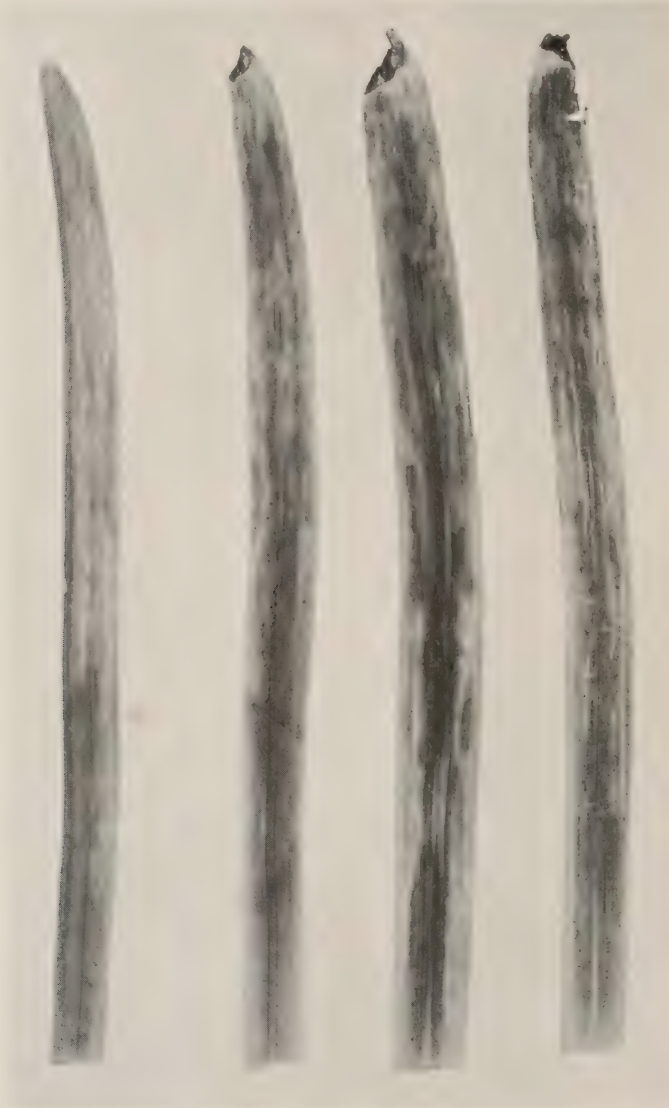


PLATE 18.—Leaves of the narcissus *Lucifer* showing mosaic-like mottlings.

and a lighter colour of the foliage in mass. The affected plants show decidedly reduced vitality and stature. They apparently do not recover their normal colouring, at any rate after the end of the three years' growth during which affected plants have been under observation.

It is possible that this is a virus disease of the mosaic type and it is advisable for the bulb-grower to discard plants affected in this way as soon as they are observed.

HYACINTH DISEASES

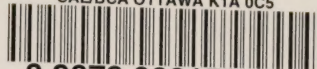
The outstanding malady to which hyacinths are subject is one known as the "yellow disease," caused by the organism *Bacterium Hyacinthi* Wakker.

The leaves of the affected plants develop narrow dark stripes near and parallel to the edge. The vigour of growth is impaired, the leaf tips turn yellow and roll up, and in an extreme case, in a few days, the whole shoot with the inflorescence can be easily pulled out of the bulb. In the bulb there is a decay progressing from the apex downwards accompanied by a gradual discolouration of the tissues until the scales are separated from the base of the bulb. The disease is favoured by the retardation of growth which results from prolonged wet weather after planting the bulb. Fortunately this disease does not infect the soil, the bacteria being spread by the splashing of rain and contact in storage.

There is no known cure for this disease and thus the control method is one of eradication. Diseased plants should be dug up and burned. Newly purchased bulbs should be examined so that those showing soft decayed areas can be destroyed and not become a source of infection in the field.

NOTE. The Division of Botany will be glad to receive specimens of bulb diseases for identification. Parcels under 16 ounces in weight and addressed to the Dominion Botanist, Central Experimental Farm, Ottawa, can be sent free of postage.

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